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The Journal

OF THE

AMERICAN ASSOCIATION OF NURSE ANESTHETISTS

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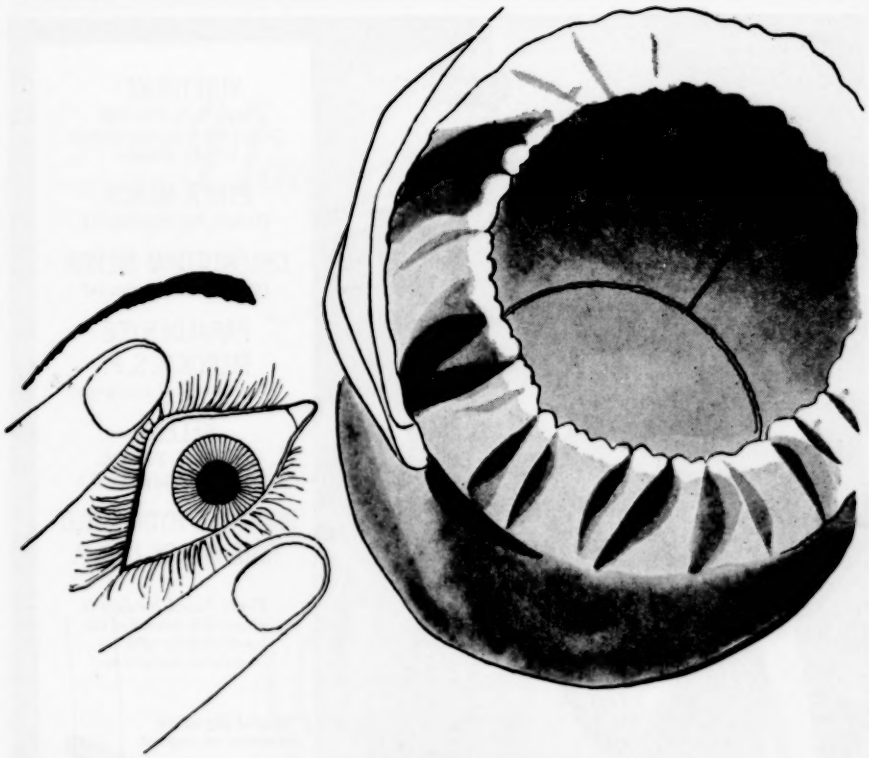

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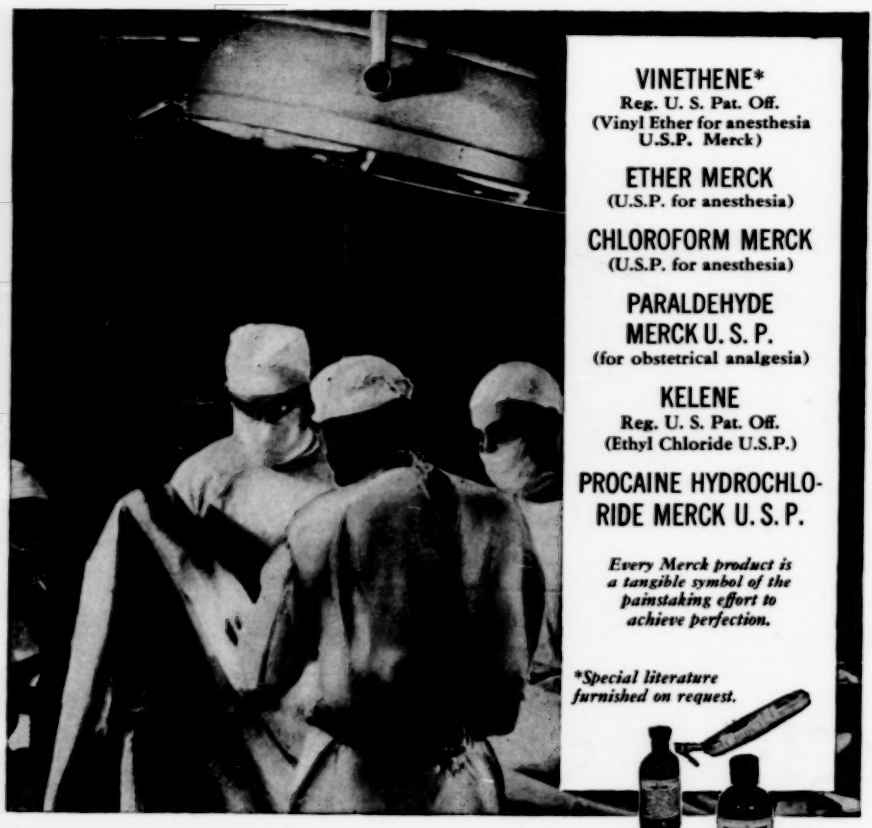

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The Journal of the American Association of Nurse Anesthetists

VOLUME XV NOVEMBER, 1947 NUMBER FOUR

Report of the President

It is fortunate that the President must give an account of her stewardship each year at the annual meeting. In so doing she must record the accomplishments, and at the same time she comes face to face with the things that have not been accomplished.

Each year the Association should increase its usefulness to our profession, and each year it should gain in prestige. If our association is to live and grow as it has in the past, it will do so because of the vigor and repute which new believers in its destiny have added to the confidence and loyalty of old associates, and because of the continued effort put forth by all of us to further the aims and aspirations of this association.

The Board of Trustees held two meetings this year, one in Philadelphia following the thirteenth annual convention, and one in Chicago on February 14, 1947. At the meeting in Philadelphia the Board voted to appoint a full-time Editor, who was also to be responsible for public relations activities as carried on from headquarters. The Board also voted to appoint an Educational Director. In addition the Board approved, at the request of the Treasurer, that the keeping of the Treasurer's books should be transferred to the Executive Office in Chicago.

As a result of the Board's decision, Virginia S. Thatcher joined the Executive Staff the middle of January as Managing Editor of the JOURNAL. Miss Thatcher came to us with a background of several years' experience in the editing of medical papers and the preparation of scientific magazines.

As yet, an Educational Director has not been appointed. It is the Board's desire that this position be filled by one of our own members. Up to this time, those whom we have considered and who have the qualifications are unwilling to leave their present posts because of the great need for teachers and anesthetists in the field. We are hopeful that the right person may be available in the near future.

As Chairman of the Board, I attended the annual meeting of the Texas State Association of Nurse Anesthetists and the meeting of the

Tri-State Assembly. I thoroughly enjoyed both meetings, and I was greatly impressed by the time and effort being put forth by the leaders in our states.

An institute, sponsored by the American Association of Nurse Anesthetists and conducted by the American Hospital Association, was held in New Orleans in May. From the reports it was most successful, and I wish I could have attended. The Association also sponsored two educational exhibits during the year, one at the Congress of the International Council of Nurses in Atlantic City and the other at the Catholic Hospital Association convention in Boston.

When the war came to an end, we all hoped that many of our problems would quickly disappear. The end of the war has brought forth not only a hangover of many of our old problems but many new ones. There is still a great shortage of anesthetists. There may be a shortage of students in our schools, because of the diminished number of students entering schools of nursing. To discuss these problems, the Board of Trustees thought it advisable to call a special meeting for the directors of the schools of anesthesia. It is the first time that such a meeting has been held, and we are hopeful that the schools will find some solution to the many problems facing them.

I wish to express my appreciation to the Board of Trustees for their help and encouragement and to the state associations for the help they have given us. I especially appreciate the work that has been done by the committees this year. The reports of these committees will prove to you the amount of work that has been done by our members. The accomplishments of these committees are especially appreciated when it is remembered that their work was done by members who are carrying full-time positions in anesthesia.

Lucy E. Richards, President

TRENDS IN ANESTHESIA AS INDICATED BY A SAMPLING OF THE LITERATURE

Florence A. McQuillen, M.A.A.N.A., and
John S. Lundy, M.D.*
Rochester, Minn.

"Trends" is a popular word in the titles of articles pertaining to anesthesia. By what process trends are determined by the authors is rarely stated. Observations of actual practice, personal experience, or a study of the literature may have been, either alone or in combination, the methods used to indicate the course which is being taken in the practice of anesthesia. At times during the preparation of material for publication in *Anesthesia Abstracts* and the reading of books on anesthesia, it seemed that there were patterns; use of some anesthetic agents or methods was declining while interest in others was increasing. To determine, if possible, these or any other patterns was the object of this study.

MATERIAL

Books constitute an important part of the literature on anesthesia. It was decided to make them the subject of a separate study which it is hoped will be reported later. The "papers" or articles which appear in periodicals are another large part of the literature. It is with this group that this study is concerned. To follow the pattern for more than the century since the introduction of anesthesia for clinical use might be interesting, but a task of such magnitude was not feasible at this time. The material chosen for this study was the abstracts of the 5,900 articles from medical journals prepared for publication in the first 24 volumes of *Anesthesia Abstracts*.[1] Most articles abstracted in those volumes were published in a period of 12 years, 1935 through 1946.

Our familiarity with the content of those articles made these abstracts particularly suitable for study. Some articles included in *Anesthesia Abstracts* were published before 1935; some as early as 1842. Because a great degree of selectivity had been used in choosing those earlier articles, and because they represent such a small part of the total literature for that period, they were omitted from this study. Because the articles published in 1947, abstracts of which will appear in volume 24, represent an incomplete picture for that year, they, too, were omitted. Abstracts of articles on blood transfusion which have appeared in *Anesthesia Abstracts* also were deleted because much selectivity had been used in this category and it was believed that a fair pattern would not result. After these deletions the

Read before the Fourteenth Annual Meeting of the American Association of Nurse Anesthetists, St. Louis, Sept. 22, 1947.

*From the Section on Anesthesiology, Mayo Clinic.

1. The Journal Club: **Anesthesia Abstracts** (Minneapolis: Burgess Publishing Company, 1937 to 1947) vols. 1 to 23; vol. 24 (in press).

Approximate Number of References in Quarterly Cumulative Index Medicus under Heading of Anesthesia

Year	*Total for year*	*English language*	*Per cent*	*Foreign language*	*Per cent*
1935	829	299	36	530	64
1936	908	393	43	515	57
1937	901	348	39	553	61
1938	898	373	42	525	58
1939	908	372	41	536	59
1940	715	406	57	309	43
1941	718	435	61	283	39
1942	542	419	77	123	23
1943	593	424	72	169	28
1944	652	463	71	189	29
1945	650	396	61	254	39
1946	712*	378*	53	334*	47
Totals	9,026	4,706	52	4,320	48

*1946 figures estimated from first half of year.

remaining number of abstracts totaled 5,107. These actually constitute the material for this study.

How much of the total literature do these articles represent? There are about 5,000 medical journals[2]; of these only 1,200 were available as sources for material for *Anesthesia Abstracts*. It would seem then that less than 25 per cent of the material was reviewed. Actually of the 1,200 journals only 283 contained articles on anesthesia. These 283 journals represent only 5.6 per cent of the 5,000 journals. That would seem to be a very small part of the total literature. These percentages give a misleading picture of the percentage of articles used as compared with the total published. A more accurate idea will be obtained from a survey of the references in *Quarterly Cumulative Index Medicus* for the years covered by this study (see table).[3]

The 5,107 abstracts of articles with which this study is concerned actually represent more than 56 per cent of the total and 109 per cent of the articles on anesthesia printed in the English language as indicated by the *Quarterly Cumulative Index Medicus*. A few translations, some excerpts from articles on surgical and other systems, and from listings other than "anesthesia" in the *Quarterly Cumulative Index Medicus* account for this high percentage.

No attempt was made to include chapters in books, all systems of medicine and surgery, or material from ad-

2. Bulloch, William: Medical periodical literature. Reviewed in Brit. M. J. 2:810-812, Oct., 1935.

3. **Quarterly Cumulative Index Medicus** (Chicago: American Medical Association, 1935 to 1947) vols. 17 to 41.

vertising journals. From the available periodicals in English all articles on anesthesia were abstracted, and, as said before, a few but not many translations from foreign languages were made.

Method of Classification

The abstracts were reviewed, and each was placed into a category which indicated the main subject, or subjects. The titles were not always a true indication of the content of the article. If there were three or less main subjects in an article, each subject was classified separately. Thus, in the details on most subjects which follow, the word "reference" is used. When an author discussed more than four subjects in one article, that article was placed in a subcategory called "general discussion." Four main categories were used as follows: (1) agents, (2) methods, (3) applications, and (4) miscellaneous subjects. Articles which did not logically fall into the first three categories were placed, for purposes of this study, in the fourth group, although there was no relationship between some of the subjects. The data on agents were arranged in two groups: agents used for general anesthesia, and those used for other types. Graphs were then constructed for each of the subjects in each category. From these graphs it was hoped that patterns or trends could be deduced.

Agents (figs. 1 and 2) Used for General Anesthesia

Barbiturates.—Of all agents used for producing general anesthesia, the barbiturates were the subject of the largest number of references during the 12 year period. All articles on barbiturates in which the drugs themselves were the subject of the discussion were included in this category. Conversely, in the plan used, when the method was the main subject of an article, the incidental mention of a drug or drugs did not constitute enough interest to warrant its inclusion in this group.

In 1935, there were 44 major references to the barbiturates. A sharp increase occurred in 1936, followed by a consistent decline in interest until 1940, when only 25 references appeared. Gradual increase of interest resulted until 1944 when another, less acute decline occurred, and in 1946 the interest as indicated by the number of references again increased. During the 12 year period 574 references on the barbiturate group of drugs appeared.

Cyclopropane (fig. 1).—Of the agents which are used for general anesthesia, cyclopropane was the subject of the second largest group of articles. Here the greatest number appeared in 1937 when there were 26 references. The total number of references during the 12 years was 153.

Ether (fig. 1).—Diethyl ether was considered as a single unit; some of the newer ethers were placed together in another group. Diethyl ether was the main subject of 129 references with no spectacular increase or decrease of interest throughout the period under consideration.

Nitrous oxide (fig. 1).—This was the fourth agent of interest as indicated by 122 references. There was a marked peak in 1937.

Divinyl ether (fig. 2).—The fifth in this series of general anesthetic agents has been the subject of 45 major references with slight peaks of interest in 1937 and 1938.

Trichlorethylene (fig. 1). — There were 37 references on trichlorethylene, and the peak of interest was in 1943.

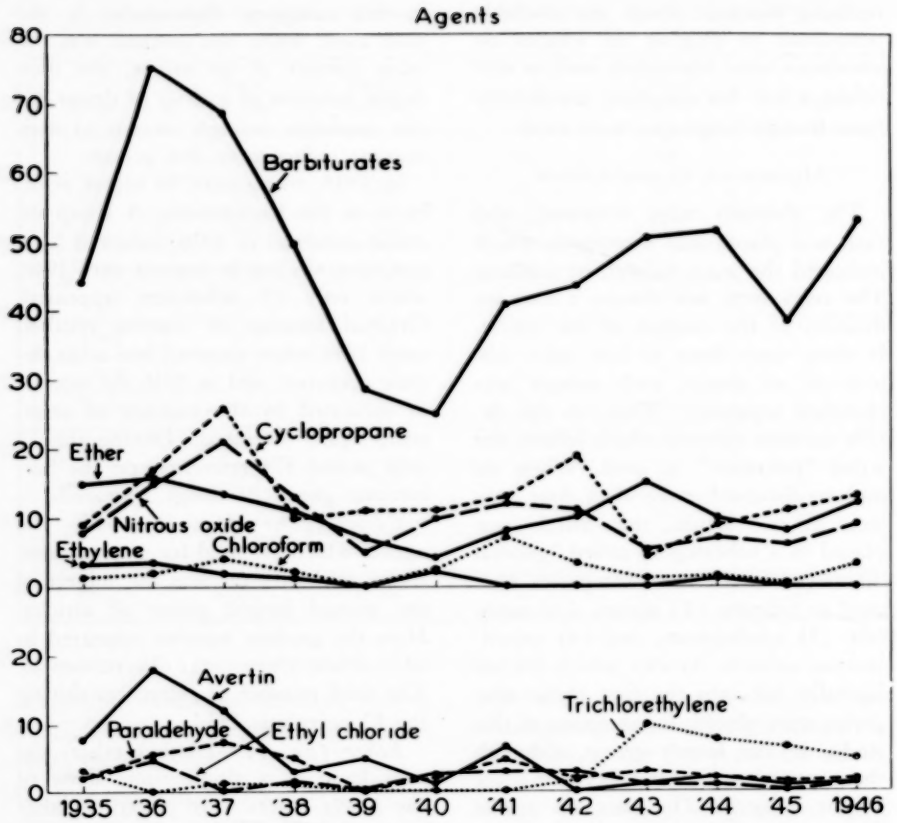

Fig. 1.—Variation in the number of articles on agents used for general anesthesia in 12 years, 1935 through 1946. See figure 2 for data on newer ethers and divinyl ether.

Chloroform (fig. 1).—The 26 references on chloroform make it seventh in line of interest which increased slightly in 1941.

Ethyl chloride (fig. 1).—This was eighth in the group with 19 references.

Newer ethers (fig. 2).—This subgroup includes cypreth, cyprome, cyprethylene, and others of the recently introduced ethers. Sixteen references appeared on these newer ethers, the first of which was in 1938. The number of references on these agents was ninth in the group.

Ethylene (fig. 1).—The tenth and last agent in this group was the subject of a declining interest. Of the 12 articles primarily concerned with this agent only one has appeared in the past six years.

Agents Other Than Those Used for General Anesthesia (fig. 2)

Local anesthetic drugs.—In this group, as in the barbiturate group, distinction was made between the agent and the method. Of all of the agents, local anesthetic agents were the subject of the second largest number of refer-

ences, a total of 241 having appeared. The point of least interest as indicated by the number of references occurred in 1938 and of greatest interest in 1944.

Analeptics.—These drugs were the subject of 183 articles. There were marked peaks of interest in 1939 and 1942, with the lowest points in 1943 and in 1945.

Agents for premedication.—This has been the main subject of 210 articles with a gradual increase from 1940 to 1946.

Oxygen, carbon dioxide, and helium.—These gases have been the subjects of 76, 29, and 15 articles, respectively. Interest in each has declined.

Avertin.—A peak of interest in this drug was reached in 1936 when 18 of the 59 references on the subject appeared.

Paraldehyde.—Interest in paraldehyde as in avertin has declined during the period under consideration. Thirty-nine references are listed during that period with a peak in 1937.

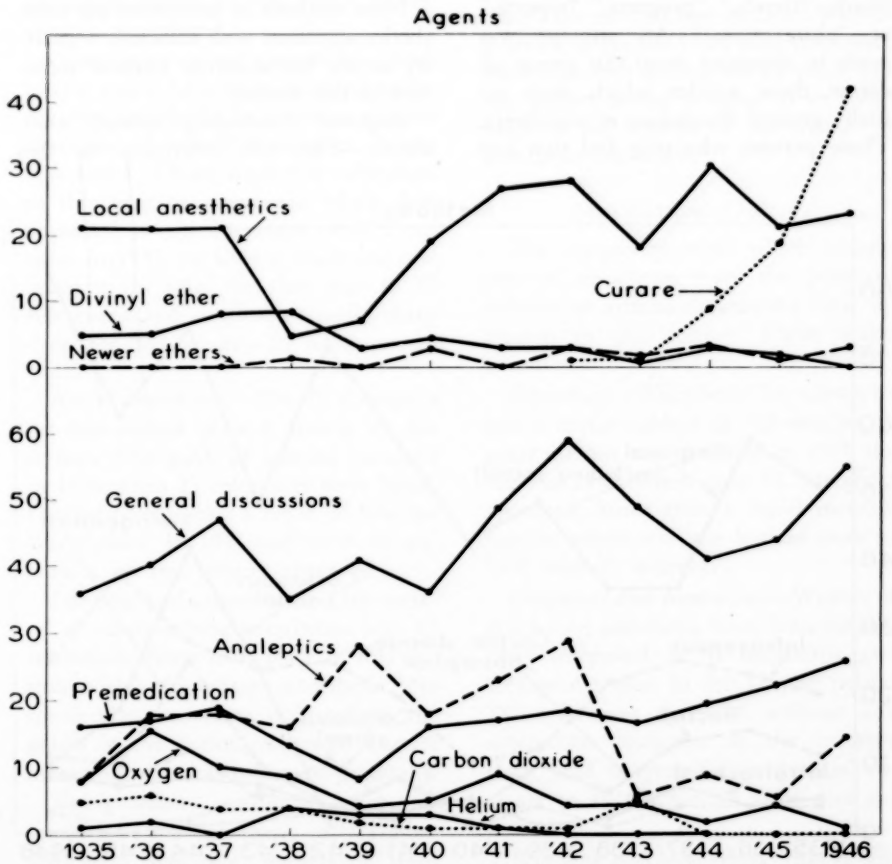

Fig. 2.—Variation in the number of articles on divinyl ether, newer ethers, and certain other agents from 1935 through 1946.

Curare.—This agent, which appeared in the literature on anesthesia for the first time in 1942, has been the main topic of 72 articles, 42 of which appeared in 1946.

General Discussion (fig. 2) of Certain Agents and Methods

In this group are included all those articles in which so many agents or methods were mentioned that no attempt was made to break them down into the other categories. Such articles were often reviews or general surveys and often contained in their titles the words, "trends," "progress," "reports," or "observations." An attempt was made to eliminate from this group all except those articles which were actually general discussions of anesthesia. Those persons who may feel that any one group thus far described does not give a fair picture of any particular agent may add a share of the articles from this group to his favorite agent and thus bolster its standing. A breakdown within this group to the various agents would probably add only to the size of the figure for any one agent without greatly altering its relative position in this survey. There were 532 references in this group with a marked peak in 1942 when 59 of these articles appeared.

Methods (fig. 3)

Nine methods of administering anesthetics appeared with sufficient regularity in the literature to warrant inclusion in this section.

Regional (including spinal) anesthesia.—The 673 references in this

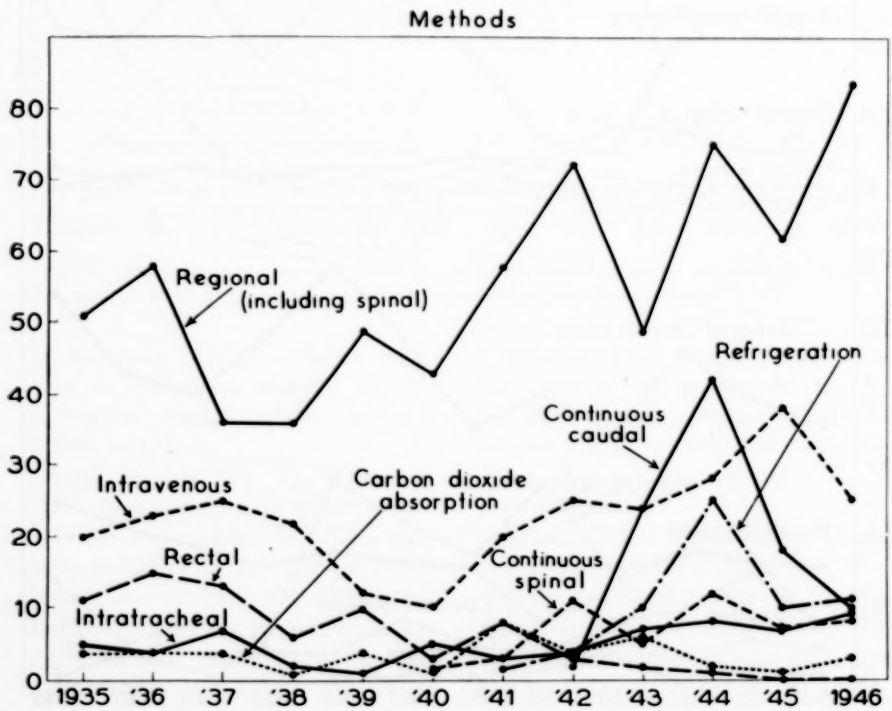

Fig. 3.—Variation in number of articles on nine methods of use to anesthetists.

group make this subject the one of greatest interest in the whole series. Since the lowest point in 1937 and in 1938 when 36 references appeared each year, there has been an erratic rise in number up to 1946 when 83 references appeared. This number was the greatest single figure for any subject for any one year.

Intravenous anesthesia.—The 287 references on this subject during the 12 year period make this method second in importance as indicated by this study. The greatest peak in number of articles occurred in 1945, when 38 references were listed.

Continuous caudal anesthesia.—This subject could have been included under regional anesthesia. Its newness was the criterion on which a separate listing was based. There were 106 references to this type of anesthesia which first appeared in the literature with 2 articles in 1942. In 1944 a sharp increase brought the total for that year to 42 references, and an almost equally sharp drop resulted in only 10 references in 1946.

Rectal anesthesia.—The 72 references on this subject place it fourth in this section. The peak of interest occurred in 1936 when 15 references were listed. During recent years a rapid decline has taken place; in 1945 and 1946 no references on this subject appeared.

Intratracheal anesthesia.—This method of administering anesthetics with 62 references shares fifth place in this section with refrigeration anesthesia. No spectacular variations occurred in the graph in the period, although interest in recent years has increased gradually.

Refrigeration anesthesia.—In our samples of the literature, refrigeration anesthesia was not mentioned until 1941. Since then 62 references have appeared with a peak in 1944 when there were 25.

Continuous spinal anesthesia.—This is seventh in this group with 47 references to it since its introduction in 1940. Although there was no spectacular rise in interest, as there was in continuous caudal anesthesia, neither was there a precipitous fall.

Carbon dioxide absorption.—This has been the main subject of 44 references, and a slight increase of interest was noted in 1941.

Electric anesthesia (not shown in fig. 3).—This method was included because it seems to persist. Only nine references have appeared during the 12 years, but the subject seems to cling to its small hold on the interest of the writers of anesthesia literature.

APPLICATIONS (FIG. 4)

The frequency with which certain uses of anesthesia were the principal subjects of articles determined their inclusion in this section. Eight major classifications were used.

Obstetrics.—Anesthesia for obstetrics was a major subject of 318 articles. A great interest was indicated in 1937, the least in 1939, when only 14 references appeared. Since then a rapid increase may be noted with the highest peak in 1946 with 42 references.

Diagnosis and treatment.—Writers of articles on anesthesia have been consistently interested in its diagnostic and therapeutic uses. In the 12 year period 181 references appeared without any spectacular variation in the number from year to year but a gradual increase to 1946 when 33 references appeared.

Wartime uses.—Wartime uses of anesthesia have been the subject of 153

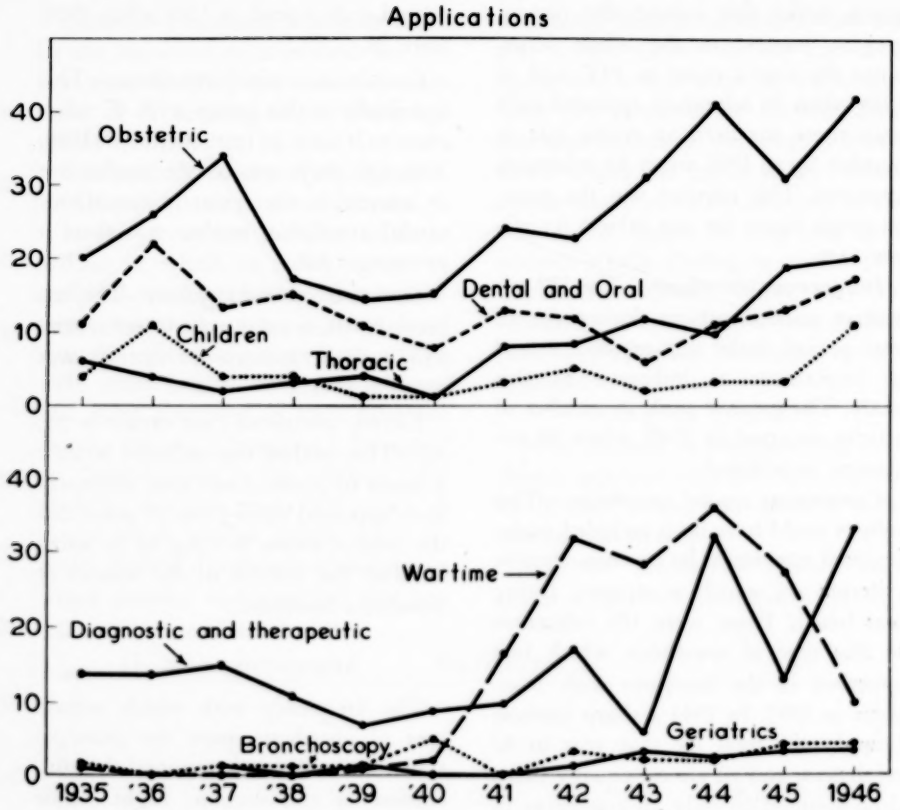

Fig. 4.—Comparison of number of articles on eight uses of anesthesia from 1935 through 1946.

articles with a peak in 1944. As early as 1935 one reference appeared, but 1941 showed the first great increase. A rapid decrease occurred in 1946.

Dental anesthesia.—Interest in anesthesia for dental and oral surgery has been sustained. No spectacular peak has occurred, although in 1936 22 of the 152 references on the subject appeared.

Thoracic surgery. — Anesthesia for thoracic surgery has been the subject of 97 references with a gradually increasing interest from 1940, when one reference appeared, to 1946, when there were 20.

Children. — Anesthesia for children has maintained a fairly constant interest with peaks in 1936 and again in 1946. A total of 62 references appeared in this group.

Bronchoscopy.—Casual but persistent interest in this subject is indicated by 24 references which have appeared with no marked variations in number over the years.

Geriatrics.—Anesthesia for the aged has been the subject of only 14 articles, 11 of which have been published since 1943 when the word "geriatrics" first appeared in these articles.

Miscellaneous Subjects (fig. 5)

Complications. — Articles in which complications during and following an-

esthesia were the main subject rank high in the total count. There were 442 in the period under consideration; two peaks of interest occurred, one in 1936, when 45 references appeared, and the other in 1944, when there were 56.

Asphyxia.—In this category were 72 references. Anoxia, anoxemia, and asphyxia were all classified in this one group. Interest has been consistent with the highest peak in 1937.

Shock.—References on this subject increased spectacularly from 2 in 1935 to 42 in 1943. The decline was equally

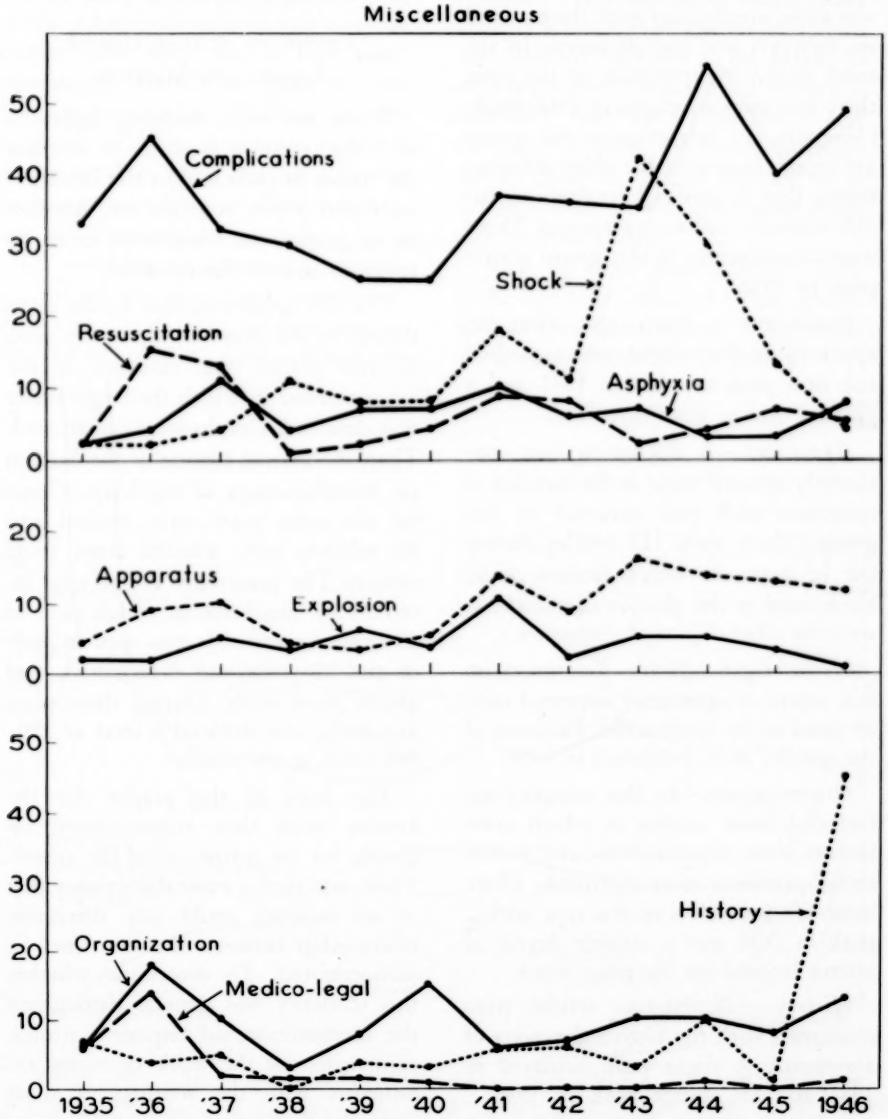

Fig. 5.—Comparison of the number of articles on nine miscellaneous subjects from 1935 through 1946.

spectacular; only four references appeared in 1946. The total number for the 12 years was 154.

Resuscitation.—We had some difficulty in properly classifying some of the articles on resuscitation because, in the older implications of the word, there was some overlapping with the material on asphyxia and complications. In the more recent interpretation of the term there was some overlapping with shock. Generally, the references in this group are representative of the older interpretation, that is, artificial respiration, cardiac massage, and such measures. There were 71 references in this group with a peak in 1936.

Explosions. — Forty-eight references appeared on this subject with a gradual rise to a peak number in 1941 and a gradual decline since that time.

Apparatus.—A fluctuating but consistently upward trend in the number of references each year occurred in this group. There were 113 articles during the 12 years, in which devices of all kinds used in the practice of anesthesia were the chief objects of discussion.

Medico-legal aspects.—References on this aspect of anesthesia appeared only 29 times in the entire series. Fourteen of the articles were published in 1936.

Organizations.—In this category are included those articles in which anesthetists, their organizations, and professional problems were discussed. There were 114 references to this type with a peak in 1936 and a variable degree of author interest for the other years.

History. — Ninety-four articles were concerned with the historical aspects of anesthesia. A slight peak occurred in 1944 and an abrupt peak in 1946.

Comment.—Other subjects could well have been included in this category of miscellaneous subjects. For instance, anaphylaxis in relation to anesthesia was the subject of six articles. In view of recent experiences with the use of macrose during anesthesia and for unanesthetized persons, interest in the subject of anaphylaxis may be revived.

Trends in Actual Use of Agents and Methods

While we were studying figures 1 to 5 the question arose as to whether the trends as indicated in the literature were also trends in actual use. Another set of graphs was constructed in an attempt to answer this question.

The 270 articles written by the anesthetists at the Mayo Clinic in the same 12 year period were classified in the same manner in which the larger series was classified. Graphs were constructed. Then the annual reports of the Section on Anesthesiology of the Mayo Clinic for the same years were studied and 10 subjects were selected from those reports. The percentage of the total instances of anesthesia in which each of 10 drugs or methods was used in each of the 12 years was determined, and graphs were made. During these years anesthesia was induced a total of 280,860 times at the clinic.

The lines of the graphs for the articles were then superimposed on graphs for the actual use of the agents. There was such a great discrepancy that in no instance could any detectable relationship between the two lines be demonstrated. To determine whether this tendency was general throughout the literature would require a similar comparison of the work of many anesthetists with the writings of those same anesthetists.

An attempt then was made to com-

pare the use of anesthetic agents or methods with the trends as indicated by the larger sample of the literature. The same lines of the graphs of the 10 subjects from the clinical use of the drugs and methods at the Mayo Clinic were superimposed on the line of the related subjects in the original graphs. Here there was at least some relationship but still no exact or even close approximation. Shifting of the graphs to adjust to the common delays of two or three years did not improve the comparison. Some of these comparisons are illustrated in figure 6.

The solid line represents the percentage clinical use of regional and spinal anesthetic agents. The broken line is the course of the same subject in the literature. No close relationship exists here. Another solid line represents the use of intravenous anesthesia in clinical practice, and the dotted line is that of the graph of the same method as indicated in the literature. Here again no true relationship exists. Other subjects showed even greater diversions and were not included in the graph. In only one instance was there a noticeable similarity; that was in the use of curare (fig. 6). Here the trend, although not so great in clinical practice as in the literature, was in the same direction for both graphs.

What do these graphs show? Some of the trends as indicated by the graphs lead to further questions. Some interesting observations can be made.

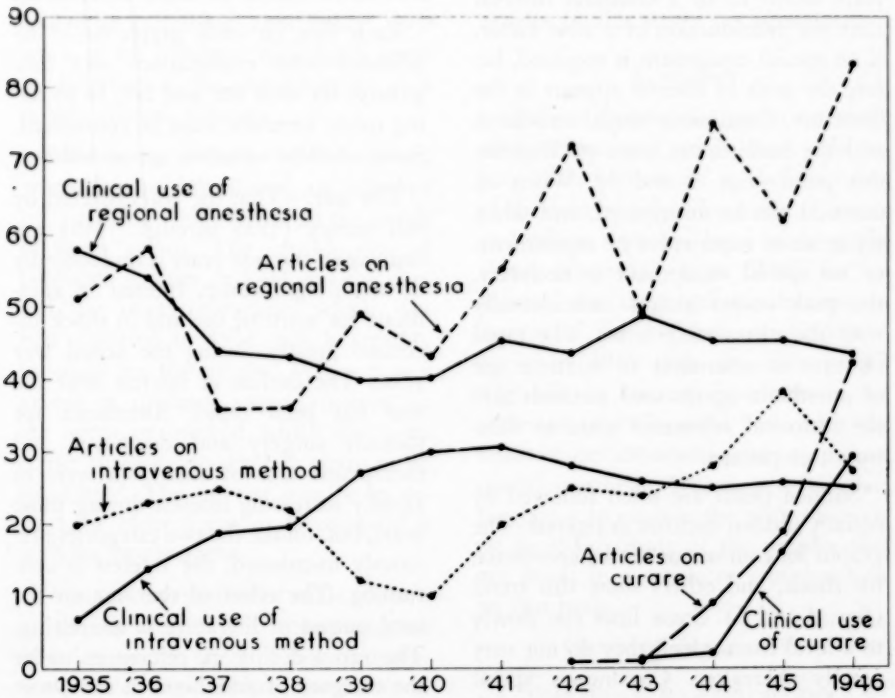

Fig. 6—Comparison of trends indicated by number of articles with actual use of agents or methods as determined by the percentage of the total instances of anesthesia in which they were used. Data came from the annual reports of the Section on Anesthesiology of the Mayo Clinic.

Interpretation of Graphs

The older agents and methods seem to have established a pattern from which they digress only after the introduction of a stimulating factor. That factor may be a competing agent or method, new evidence in favor of or opposed to the older agent or method, or new methods for applying old agents and vice versa.

Newer agents and methods seem to have a peak of interest in the literature two or three years after their introduction. It seems that when new methods or agents which are introduced require elaborate or new apparatus for their administration the lag is three years. Cyclopropane and continuous spinal anesthesia may be in this class. Two years seems to be a common interval after the introduction of a new factor, if no special equipment is required, before the peak of interest appears in the literature. Continuous caudal anesthesia and the barbiturates seem to illustrate this point (figs. 1 and 3). When an occasion can be anticipated, and when no series of experiences or experiments or no special equipment is necessary, the peak occurs almost coincidentally with the stimulating factor. The rapid increase in references to wartime use of anesthetic agents and methods and the historical references seem to illustrate this pattern.

Sudden peaks are often followed by equally sudden declines in interest. The graphs for continuous caudal anesthesia, for shock, and others show this trend (figs. 3 and 5). Some lines rise slowly to a level from which they do not vary greatly thereafter. Continuous spinal anesthesia is an example of this trend.

Some lines seem to follow a pattern almost parallel to that of another agent or method. Avertin and paraldehyde have such a course. Being somewhat similar in method of administration and application, this relationship seems understandable. Nitrous oxide and cyclopropane also have similar patterns. The relationship is less apparent than with avertin and paraldehyde, and the significance of the parallelism is conjectural.

There seems to be no definite correlation of interest in certain drugs per se and the methods by which they are given. For instance, local anesthetic agents do not follow the same line as that for regional anesthesia, nor does the line for barbiturates appear to be correlated with the line for the intravenous method although it would seem that there should be some correlation.

Each line on each graph could be followed with explanations and conjectures for each rise and fall. In so doing many variables must be considered. Some of these variables are as follows:

The war.—That the years covered by this survey (1935 through 1946) encompassed the war years is undoubtedly of much significance. Interest in anesthesia for wartime use and in shock increased greatly during the actual war years. The decline of interest after the war has been rapid. Anesthesia for thoracic surgery and diagnostic and therapeutic uses of anesthesia were of rapidly increasing interest during those years, but, unlike the two categories previously mentioned, the interest is continuing. The effect of the war on the total output of literature is interesting. The rapid decline in references under the category of anesthesia in the *Quarterly Cumulative Index Medicus* and the beginning recovery are apparent in the table. The geographic sources of

articles also underwent an understandable change. This trend can also be followed in the figures in the table. The material from journals printed in foreign languages varied from 64 per cent in 1935 to 22 per cent in 1942.

Authors.—Some authors are prolific in their output of articles on anesthesia. When such an author becomes the protagonist for a certain agent or method he may influence the trend in anesthesia as it is indicated in the literature. His enthusiasm for his own or another person's contribution to the field of anesthesia may distort the pattern as it represents the actual clinical trend. Sometimes an author may contribute almost identical papers to several periodicals, again distorting the pattern. Failure of some workers to contribute anything concerning their work to the literature may again result in distortion of the pattern as far as it reflects clinical practice.

Stimulating factors.—New agents, when they are introduced, are followed by fairly discernible effects on the trends of those agents. The introduction of pentothal sodium in 1934 and the clinical use of cyclopropane, which was first reported in 1934, can be readily followed on the graphs. When newer agents or methods appear, interest in the agent or method which the newcomer threatens to displace seems to be stimulated. The interest may be to defend the older agent or to compare it with the newer agent.

When a contribution of value is made to the literature, it is interesting to speculate on the effect of that contribution on the trends. How, for instance, did Courville's monograph on asphyxia as a consequence of nitrous oxide anesthesia affect the trend of the graphs for asphyxia and for nitrous oxide?[4] Did Moon's book on shock affect the trend of interest in what subject?[5] Could the sudden peak of interest in continuous caudal anesthesia be partially attributed to the fact that its originator was the author or co-author of more than 10 per cent of the references? Did the death of J. T. Gwathmey in any way contribute to the decline of interest in rectal anesthesia?

Physician anesthetists.—Did the increasing interest of physicians in the specialty of anesthesia greatly affect the trends? It is probably too early to evaluate this factor. It seems significant that although it has been estimated that in five out of six instances anesthetic agents are not administered by physicians, the preponderance of authors of articles in this study are physicians.

COMMENT

Endless speculations could be made along these and other lines. No attempt has been made to explain many of the trends. A greater study of causes and effects than has been made might reveal interesting facts. Why, for instance, was there greater interest in anesthesia for children in 1936 and again in 1946 than in other years? The rise in interest in anesthesia for obstetrics in 1944 could have been the result of the introduction of continuous caudal anesthesia. Was there a stimulating factor to explain the peak of interest in 1937? Study of the graphs does not result in a satisfactory explanation on that basis.

(Continued on page 224)

4. Courville, C. B.: Asphyxia as a consequence of nitrous oxide anesthesia. Medicine **15**:129-245, May, 1936.

5. Moon, V. H.: **Shock and Related Capillary Phenomena** (New York: Oxford University Press, 1938) 442 pp.

KIDNEY FUNCTION IN ANESTHESIA

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PHYSIOLOGY OF THE KIDNEYS

Structure

A. Functional unit.—The functional unit of the kidney is the nephron. There are about one million nephrons in each human kidney. The parts of the nephron are the renal corpuscle and the tubules. A renal corpuscle consists of a glomerulus, or tuft of capillaries, and a surrounding capsule, which is made up of two layers of epithelial cells. The total surface area of the glomerular capillaries is between 1 and 1.5 sq. M.; this indicates the great size of the filtering surface.

The tubules have a surface area of about 6 sq. M. and a total length of about 45 miles; this extensive surface is concerned with reabsorption. The tubule differs in structure along its course and is described as proximal convoluted, loop of Henle, distal convoluted, and collecting portions, as it passes from the glomerular capsule to the pelvis of the kidney.

B. Blood supply.—There are two capillary beds in the kidney: one is the glomerular tuft, and the other surrounds the tubules. It is possible, however, for the blood to by-pass the glomerular tuft and pass directly to the capillary network around the tubules. There are three ways by which the glomerulus may be excluded from the circulation: (1) some interlobular arteries terminate directly in the peritubular capillary plexus; (2) the afferent arteriole may give off a twig which goes directly to the capillary plexus around the tubules; (3) arterioles arise from the subcortical or interlobular arteries to descend directly into the medulla; these are called the arteriolae rectae verae.[1, 2] These by-passes become important in shock, as will be shown later. The afferent arteriole of the glomerulus has a diameter twice as great as that of the efferent arteriole. Portions of the afferent arteriole and of the distal convoluted tubule, where it returns to lie adjacent to the afferent arteriole, are modified in structure and together form the juxtaglomerular apparatus, which seems to be an endocrine structure; under certain circumstances it produces renin.[3,4,5]

C. Nerve supply.—The nerve supply to the kidneys seems limited to the blood vessels, as vasoconstrictor nerves, and to the juxtaglomerular apparatus, as secretory nerves.

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1. Smith, H. W.: Physiology of the renal circulation. Harvey Lectures, Series **35**:166-222, 1939-40.

2. Shonyo, E. S., and Mann, F. C.: Experimental investigation of renal circulation. Arch.Path. **38**:287-296, 1944.

3. Leiter, L.: Kidney. Ann. Rev. Physiol. **3**:509-542, 1940.

4. Graef, I., and Smith, H. W.: The nature of the afferent arteriolar tissue in the mammalian kidney, and the changes induced therein by renal ischemia. J.Clin.Investigation **19**:770, 1941.

5. Quinby, W. C.; Dexter, L.; Sandmeyer, J. A., and Haynes, F. W.: The renal humoral pressor mechanism in man. II. J. Clin. Investigation **24**:69-74, 1945.

FUNCTIONS OF THE KIDNEYS

The main function of the kidneys is to eliminate nitrogenous waste products of protein metabolism, the principal one being urea.

A second function is to aid in the maintenance of water balance by excretion of an abundance of dilute urine when fluid is plentiful and a small amount of highly concentrated urine when fluid intake is limited or when a great output occurs by another channel (e.g., excessive sweating, vomiting, diarrhea).

A third function is to aid in the maintenance of acid-base stability.[6,7,8] An acid urine, with a pH of 4.0, or an alkaline urine, with a pH of 8.0, can be produced, as needed, to keep the pH of the blood relatively constant (7.28 to 7.42). This variability of kidney function constitutes the second line of defense of the body against marked changes in the acid-base condition. The kidneys, therefore, are important assistants to the respiratory system, which is the first means of defense. One may think of the kidneys as playing an important role in maintaining the constancy of the environment of the tissue cells, or homeostasis, by their aid in the regulation of the composition of the blood and tissue fluid.

THE MECHANISM BY WHICH URINE IS PRODUCED

A. Function of the glomeruli.—The glomeruli act as filters. The blood pressure in the glomerulus furnishes the force for filtration. Water and all the substances in solution in the plasma, except the colloids, filter through the capillary wall into the lumen of the capsule. The colloids (proteins) of the plasma, by exerting osmotic pressure, oppose filtration, so that only a fraction of the plasma water filters off as the blood traverses the glomeruli. The pressure in the glomerular capillaries is increased by a general increase in arterial blood pressure and by constriction of the efferent arteriole. It is decreased by a fall in general arterial blood pressure and by constriction of the afferent arteriole. The amount of filtration which occurs in the glomeruli is altered by such changes in glomerular blood pressure.

A change in concentration of plasma proteins will alter filtration; if the proteins are diluted, there is less opposition to filtration, and the amount of filtrate is increased. The opposite condition may occur. Richards and his associates collected and analyzed glomerular filtrate and found it like plasma in reaction and composition except for proteins.

The permeability of the capillary wall is increased by hypoxia; when this condition supervenes, albumin escapes from the plasma and appears in the urine.

B. Functions of the tubules.—The various functions which the tubules can perform are: reabsorption of substances from the glomerular filtrate, excretion of foreign substances from the plasma into the filtrate, and the synthesis of substances such as ammonia. Other substances may diffuse passively back from the filtrate into the plasma if the diffusion gradient is sufficiently great.

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6. Pitts, R. F.: The renal regulation of acid-base balance with special reference to the mechanism for acidifying the urine. I. Science **102**:49-54, 1945.

7. Pitts, R. F.: The renal regulation of acid-base balance with special reference to the mechanism for acidifying the urine. II. Science **102**:81-85, 1945.

8. Pitts, R. F., and Lotspeich, W. D.: Bicarbonate and the renal regulation of acid-base balance. Am. J. Physiol. **147**:138-154, 1946.

The reabsorption in the tubules is selective; only those materials which are useful to the body are actively absorbed, such as glucose, base, and water. Some urea diffuses passively from the lumen of the tubules back into the blood stream.[9,10] Richards' associates, by collecting fluid at various tubular levels and analyzing it, located the levels at which each useful substance is absorbed.[11] There is a limit to the amount which the tubules can absorb in a given time; beyond this limit even useful substances, such as glucose, spill over into the urine. The maximal absorptive capacity can be measured; this constitutes one of the recently introduced tests of kidney function.

Excretion by the tubules is normally a latent function in the human kidney. However, it can be brought into action by the injection of foreign substances into the blood stream. Such substances as diodrast, para-aminohippuric acid (expressed as PAH from now on), and penicillin are excreted by the tubular cells. This function, like that of reabsorption, is easily saturated; the maximal excretory function of the tubules may be measured, and it gives an idea of the renal function of the individual. If more than one foreign substance is presented at a time, there is competition for excretion; this principle is utilized at the present time by injecting diodrast or PAH with penicillin in order to keep the blood level of penicillin high for a longer time.[12,13]

9. Smith, H. W.: Kidney. Ann. Rev. Physiol. **1**:503-528, 1939.

10. Dole, V. P.: Back diffusion of urea in mammalian kidney. Am. J. Physiol. **139**:504-513, 1943.

11. Walker, A. M.; Bott, P. A.; Oliver, J., and MacDowell, M. C.: Collection and analysis of fluid from single nephrons of mammalian kidney. Am. J. Physiol. **134**:580-595, 1941.

The degree of synthesis of ammonia varies with the acid-base condition of the blood. If there is need to eliminate base, the synthesis of ammonia is suppressed, and sodium is eliminated, as it is in alkalosis during prolonged vomiting. If there is need to eliminate acid, as in starvation, or diabetic or nephritic acidosis, the synthesis of ammonia is accelerated, and sodium is retained.

The activity of the tubules is influenced by the composition of the blood, by the amount and kind of waste in the tubular lumen, and by certain hormones. The antidiuretic factor of the posterior pituitary gland stimulates the reabsorption of water in the loop of Henle. The adrenal cortical hormone stimulates the absorption of sodium[14] and the elimination of potassium. The steroid hormones of the ovaries and testes stimulate the retention of water and sodium.[15]

The activity of the tubules is impaired by ischemia and hypoxia.

The Volume of Urine

The glomeruli filter about 125 cc. water per minute, and the tubules reabsorb about 124 cc., so that the average flow of urine is 1 cc. per minute. In 24 hours, about 180 L. are filtered and 178.5 reabsorbed. The maximal

12. Rammelkamp, C. H., and Bradley, S. E.: Excretion of penicillin in man. Proc. Soc. Exper. Biol. & Med. **53**:30-32, 1943.

13. Beyer, K. H.; Flippin, H.; Verwey, W. F., and Woodward, R.: The effect of para-aminohippuric acid on plasma concentration of penicillin in man. J.A.M.A. **126**:1007-1009, 1944.

14. Thorn, G. W.; Garbutt, H. R.; Hitchcock, F. A., and Hartman, F. A.: Effect of cortin upon renal excretion of sodium, potassium, chloride, inorganic phosphorus and total nitrogen in normal subjects and in patients with Addison's disease. Endocrinology **21**:213-219, 1937.

15. Sauter, K. E.: Androgens: their influence on kidney function. Marquette M. Rev. **9**:165-168, 1944.

urine flow, at the height of diuresis, is about 20 cc. per minute.

The excretion of water depends not only upon the quantity of water available but also upon the amount and nature of the solutes requiring elimination. Water and salts can be absorbed in the most variable amounts to preserve the volume and electrolyte patterns of the body fluids. The amount of water excreted by the kidneys varies with that eliminated by other channels, with the intake, with the diet, with the metabolic rate, and other factors. Under the usual conditions of temperature and humidity, 40-60 per cent of the total fluid intake of the 24 hours is excreted by the kidneys. The variability of function according to the needs at the time is one of the most outstanding characteristics of normal kidneys.

Clearance Tests

The term "clearance" refers to the volume of plasma required to furnish the amount of a certain substance eliminated in the urine in one minute. It is expressed in cubic centimeters of plasma per minute. Since the clearances of various substances differ, the kidneys must handle them by different means. For example, certain substances will be filtered through the glomeruli and will pass along the tubules without being influenced in any way. The amount of such a substance filtered through the glomerulus equals the amount recovered in the urine in the same period of time. In such a case, the plasma clearance is equal to the glomerular filtration rate. Inulin and mannitol behave in this way; consequently these substances enable us to measure the glomerular filtration rate under various conditions.

Since we can measure the glomerular filtration rate, we can calculate the amount of any given substance which enters the tubular lumen and compare it with the amount in the urine in a given time. If the clearance is less than the glomerular filtration rate, the substance is being actively absorbed or is passively diffusing back during its passage along the tubules. If the plasma clearance is greater than the glomerular filtration rate, tubular excretion is taking place. If all of a particular foreign substance is being removed from the blood during its passage through the kidneys, or the plasma is completely cleared, the clearance of that substance is equal to the volume of plasma flowing through the kidneys in one minute. Diodrast and PAH, at low plasma levels, enable us to measure renal plasma flow.

At high plasma levels, diodrast and PAH will be excreted by the tubules, in addition to being filtered by the glomeruli. At such high levels, we can determine the maximal excretory capacity of the tubules; this is expressed as diodrast Tm or PAH Tm. The total amount in the urine minus the amount filtered by the glomeruli gives the amount excreted by the tubules per minute.

It was stated earlier that glucose at high plasma levels enables us to measure the maximal reabsorptive capacity. The difference between the amount entering the tubules and the amount in the urine equals the maximal amount reabsorbed; this is expressed as glucose Tm.

Clearance tests are delicate tests of renal function and are our most accurate means of determining changes in kidney function at the present time.

The modern clearance methods were introduced in 1938.[16,17]

KIDNEY FUNCTION IN ANESTHESIA

Introduction

As one reviews the literature available on kidney function in anesthesia, one cannot fail to be impressed with the lack of uniformity in the methods of investigation. The experimental studies have been carried out on a variety of animals, ranging from frogs and turtles to man. One difficulty, as pointed out by Nosworthy,[18] is that the disturbance which arises from two hours of experimental anesthesia may be insignificant when compared with that following similar anesthesia associated with surgery and its complications.

The methods of administration of inhalation anesthetics vary in different laboratories, and the effects of hypoxia and asphyxia (hypoxia plus the accumulation of carbon dioxide) undoubtedly have frequently complicated the results. The stage of anesthesia is not always mentioned by the investigator; when it is mentioned, it is referred to as surgical anesthesia. Surgical anesthesia refers to a range of four planes, and the condition of the patient in the fourth plane is widely different from that in the first. Even in one department of surgery there are very different demands as to the plane of surgical anesthesia required for a given operation.

The duration of anesthesia varies in different studies; many workers have arbitrarily adopted one hour periods for inhalation anesthetics. In the operating room the patient may be subjected to the influence of anesthesia for only a few minutes or for several hours. The author has witnessed many operations which continued for more than five hours. One would certainly expect more deviation from the normal after five hours of anesthesia than after thirty minutes.

In investigative work, as well as in clinical practice, there is much variation in the use of adjuvants in premedication. Some use little or no premedication in experimental work; in clinical experience, some patients are so deeply sedated that they require small amounts of general anesthetics, and other patients are so lightly sedated that they require large amounts of general anesthetics. Some anesthesiologists use curare liberally during the operation, and therefore less general anesthesia is needed; they carry the patient in a lighter stage than would be otherwise possible.

Fluid therapy during the administration of anesthesia is subject to as wide a variation in experimental work as it is in clinical practice.

The effects of the anesthetic on body functions may be complicated at any moment by hypoxia, asphyxia, hemorrhage, shock, acidosis, change in body temperature, change in blood pressure (due to release of epinephrine, renin, or other causes), change in respiration, various surgical procedures, and position. There is probably no "steady state" ever attained in a patient during

16. Smith, H. W.; Goldring, W., and Chasis, H.: Measurement of tubular excretory mass, effective blood flow and filtration rate in normal human kidney. J. Clin. Investigation **17**:263-278, 1938.

17. Chasis, H.; Ranges, H. A.; Goldring, W., and Smith, H. W.: The control of renal blood flow and glomerular filtration in normal men. J. Clin. Investigation **17**:683-687, 1938.

18. Nosworthy, M.D.: Anesthetic problems in urology. Proc. Roy. Soc. Med. **32**:1501-1502, 1939.

the course of an operation under general anesthesia.

Postoperative observations of kidney function are rare. In order to be of worth, kidney function needs to be evaluated before, during, and after operative procedures. Fluid intake and output by various channels should be noted simultaneously.

One can see that the question of kidney function is a colossal one. Kemp,[19] in 1899, stated: "There is no known anesthetic, administered in any effective quantity, whatever the method of administration, which does not affect the renal circulation." When the renal circulation is affected, kidney function is altered.

The following authors have reviewed some of the effects of anesthesia on kidney function: Orth and Stutzman,[20] Seevers and Waters,[21] Tatum, barbiturates,[22] Sachs,[23] Mousel and Lundy,[24] Coller et al,[25] and Livingstone, ethylene.[26]

19. Kemp, R. C.: Further experimental researches on the effects of different anesthetics on the kidneys. New York Med. J. **70**:732-738; 765-772; 804-809, 1899.

20. Orth, O. S., and Stutzman, J. W.: Constancy of urea clearances in dogs following surgical anesthesias with cyclopropane, ether and chloroform. Proc. Soc. Exper. Biol. & Med. **39**:403-408, 1938.

21. Seevers, M. H., and Waters, R. M.: Pharmacology of anesthetic gases. Physiol. Rev. **18**:447-479, 1938.

22. Tatum, A. L.: Present status of barbiturate problem. Physiol. Rev. **19**: 472-502, 1939.

23. Sachs, L.: Changes in chemistry of blood and urine during and after anesthesia. Anesth. & Analg. **18**:37-47 and 101-107, 1939.

24. Mousel, L. H., and Lundy, J. S.: Role of liver and kidneys from standpoint of anesthetist. Anesthesiology **1**: 40-55, 1940.

25. Coller, F. A.: Rees, V. L.; Campbell, K. N.; Iob, V. L., and Moyer, C. A.: Effects of ether and cyclopropane anesthesia upon renal function in man. Ann. Surg. **118**:717-727, 1943.

26. Livingstone, H. M.: Present status of ethylene-oxygen anesthesia. Ann. Surg. **122**:1071-1085, 1945.

Evaluating Kidney Function

Various methods of evaluating renal damage due to anesthesia have been used. The earliest depended on noting the amount of urine eliminated. If there was oliguria or anuria, kidney damage was said to be present. Often no account was taken of intake of fluid, fluid loss by vomiting, or hemorrhage, and fluid therapy was not usually carried out during the time of operation. The next step was to test for albumin in the urine; if albumin was present in the urine, renal damage was assumed. The relation between the arterial blood pressure and renal function was noted. Later, renal function was estimated by the level of urea in the blood. If the blood urea rose during or after the administration of an anesthetic, renal damage was thought to be present. The ability of the kidneys to eliminate the dye phenolsulfonphthalein was observed. If the elimination was depressed, kidney function was thought to be impaired.

The next advance involved a simultaneous study of the levels of certain substances in blood and urine, in relation to the rate of urine flow. This ushered in the development of the clearance methods. The urea clearance was first used; since 1938, clearance studies involving the use of inulin or mannitol, diodrast or PAH, and creatinine have been used in the study of renal physiology, renal disease, and hypertension. Diodrast or PAH have been used to measure the maximal excretory function, and glucose has been used to measure the maximal reabsorptive function of the tubules; they are our most informative methods of study.

Histologic studies have always been used.

With the introduction of catheterization of the right heart and the hepatic and the renal veins, additional studies were made possible. The changes in renal circulation and renal function in various types of shock were studied intensively during the recent war.

Effects of Adjuvants

A. Premedication agents.—1. *Morphine.*—Stehle[27] thought morphine had no effect on renal function in dogs; he was interested primarily in the amount of urine eliminated and the ability of the kidneys to concentrate urea. De Bodo[28] found that morphine inhibited water diuresis in dogs; he suggested that this effect is probably due to an increased liberation of the antidiuretic hormone of the hypothalamic-hypophyseal system. He, like Stehle, was interested in the amount of urine eliminated. No studies by clearance methods have been found; we really have no thorough evaluation of renal function under the effect of morphine.

2. *Barbiturates as used in premedication.*—This question has been studied widely. Emge and Hoffman[29] studied sodium amytal combined with morphine as a premedication agent. Oliguria was more pronouced when morphine and amytal were used than when morphine and scopolamine were used, not only during but also after the operation. This was true in spite of the higher intake of fluid in the amytal group, due to the absence of nausea. The phenolsulfonphthalein excretion was more depressed in the group receiving amytal than in the other. Hirschfelder and Haury[30] found that barbiturates may be divided into two classes with respect to the site of destruction or elimination. Barbital and phenobarbital are eliminated by the kidneys. This was confirmed by many, including Schonle.[31] Walton[32] subjected dogs to one hour periods of surgical anesthesia; he found that when he used amytal, followed by ethylene, there was some depression of urinary output, water diuresis, and phenolsulfonphthalein elimination. Output of urea and chloride was unaffected.

Murphy and Koppanyi[33] damaged the kidneys in rabbits, cats, and dogs, and then administered barbital. The animals did not recover. A decreased excretion of bartital means kidney damage. It is dangerous to give the barbiturates which are eliminated by the kidneys to patients with kidney disease.

Argy[34] studied the excretion of barbital in normal and nephropathic

27. Stehle, R. L., and Bourne, W.: Effects of morphine and ether on function of kidneys. Arch. Int. Med. **42**: 248-255, 1928.

28. de Bodo, R. C.: The antidiuretic action of morphine and its mechanism. J. Pharmacol. & Exper. Therap. **82**:74-85, 1944.

29. Emge, L. A., and Hoffman, P. E.: Studies on urinary excretion in women following administration of sodium amytal. Anesth. & Analg. **10**: 88-90, 1931.

30. Hirschfelder, A. D., and Haury, V. G.: Effect of nephrectomy on duration of action of barbitals. Proc. Soc. Exper. Biol. & Med. **30**:1059-1060, 1932-33.

31. Shonle, H. A.; Keltch, A. K.; Kempf, G. F., and Swanson, E. E.: Question of elimination of barbituric acid derivatives in urine with special reference to iso-amyl ethyl barbituric acid (sodium amytal) and 1-methyl-butyl ethyl barbituric acid (pentobarbital sodium). J. Pharmacol. & Exper. Therap. **49**:393-407, 1933.

32. Walton, R. P.: Effect on kidney function of ether, ethylene, ethylene and sodium isoamyl-ethyl barbiturate (amytal), and ethylene and tri-bromethyl alcohol (avertin). J. Pharmacol. & Exper. Therap. **47**:141-149, 1933.

33. Murphy, W. S., and Koppanyi, T.: Studies on barbiturates; IV, Effects of barbiturates in experimental nephrosis. J. Pharmacol. & Exper. Therap. **52**:70-77, 1934.

34. Argy, W. P.; Linegar, C. R., and Dille, J. M.: Studies on barbiturates; XV, Excretion of barbital in normal and nephropathic subjects. J. Pharmacol. & Exper. Therap. **57**:258-263, 1936.

individuals and found that the latter excrete it very slowly and show accumulative effects with repeated doses. Masson,[35] from his study on rats, also pointed out that barbiturates eliminated by the kidneys can cause fatal accidents in patients with kidney disease.

There are no clearance studies based on the use of barbiturates as premedication agents only; they have been used as general anesthetics and will be discussed in that connection later.

3. *Tribromethanol with amylene hydrate (avertin).*—Avertin was found to lead to anuria in dogs; this period was followed by oliguria; the output of urea was diminished.[36] Walton[32] used avertin and ethylene and found slight depression of the urinary output and phenolsulfonphthalein excretion. The output of urea and chloride was not affected. Pitt[37] found a rise in blood urea when he used avertin in combination with various general anesthetics; the effect was more marked in older patients. Andersen[38] wrote an excellent review of the literature on avertin. He reported a case of toxic nephrosis after avertin in which oliguria, uremia, and coma led to death. There is no histologic change in the glomeruli; there is tubular degeneration, shown by cloudy swelling and the presence of fat droplets in the tubular epithelial cells.

35. Masson, G.M.C., and Beland, E.: Influence of liver and kidney on duration produced by barbiturates. Anesthesiology **6**:483-491, 1945.

36. Bruger, M.; Bourne, W., and Dreyer, N. B.: Effects of avertin on liver function, rate of secretion and composition of urine, reaction, alkali reserve and concentration of blood and body temperature. Am. J. Surg. **9**:82-87, 1930.

32. Loc. cit.

37. Pitt. N. E.: Influence of avertin upon renal function. Lancet **1**:741-742, 1935.

38. Andersen, D. H.: Avertin poisoning with acute yellow atrophy of the liver and toxic nephrosis. Anesthesiology **6**:284-301, 1945.

Coller et al[25] reported that they found severe decreases in both the renal blood flow and filtration rate in one patient who had been given avertin followed by ether.

In view of the above evidence, we must conclude that avertin is more likely to cause renal damage than the other agents usually given for premedication.

4. *Atropine, scopolamine and demerol.* No reports have been found.

B. During the course of anesthesia.—1. *Curare* — Griffith[39] stated that curare may apparently be given to patients with damaged kidneys without any prolongation or intensification of the effect. Cole,[40] undoubtedly influenced by Goodman and Gilman,[41] contended that a harmless dose of curare may become toxic in the presence of impaired renal function. No reports of clearance studies have been found.

REGIONAL ANESTHESIA

A. Spinal anesthesia. — Smith[42] found that patients given high spinal anesthesia, but undergoing no operation, show no evidence of change in the renal circulation. Gregory et al[43] did

25. Loc. cit.

39. Griffith, H. R.: Curare in anesthesia. J.A.M.A. **127**:642-644, 1945.

40. Cole, F.: Use of curare in anesthesia; review of 100 cases. Anesthesiology **6**:48-56, 1945.

41. Goodman, L., and Gilman, A.: **The Pharmacological Basis of Therapeutics** (New York: The Macmillan Co., 1941).

42. Smith, H. W.; Rovenstine, E. A.; Goldring, W.; Chasis, H., and Ranges, H. A.: The effects of spinal anesthesia on the circulation in normal unoperated man, with reference to the autonomy of the arterioles, and especially those of the renal circulation. J. Clin. Investigation **18**:319-341, 1939.

43. Gregory, R.; Levin, W. C.; Ross, G. T., and Bennett, A.: Studies on hypertension; VI. Effect of lowering blood pressures of hypertensive patients by high spinal anesthesia on renal function as measured by inulin and diodrast clearances. Arch. Int. Med. **77**:385-392, 1946.

not confirm this in hypertensive patients; these, when given high spinal anesthesia, showed a significant fall in inulin and diodrast clearances if there was a fall in arterial blood pressure which lasted as long as 15 minutes. The decrease in the clearance was roughly proportional to the extent and duration of the fall in the arterial blood pressure. Thus, if the blood pressure is allowed to fall, there is a change in renal function. Otherwise, the renal function is not altered by spinal anesthesia as such.

B. Continuous spinal anesthesia—Martin et al[44] studied the effects of continuous spinal anesthesia; no definite conclusions were drawn, but one patient became anuric on the third postoperative day. Lemmon[45] found no apparent interference with urine production under continuous spinal anesthesia, as evidenced by distended bladder.

C. Continuous caudal anesthesia.—No reports have been found.

General Anesthesia

A. Inhalation anesthetics.—1. *Ether.*—Kemp[19] studied the effects of ether anesthesia in dogs and observed its effects in man. He noted oliguria, which progressed to anuria, and albuminuria. He reported three cases of death after ether anesthesia, with renal signs of acute nephritis and uremia. He cautioned anesthetists against the use of ether in renal disease.

Diminished excretion of phenolsulfonphthalein was found early.[46] If morphine and atropine were used first, less effect was noted with ether, since less of it was needed. It was suggested that ether leads to vasoconstriction in the kidney with lessened blood flow; this temporary ischemia may be responsible for the renal damage.

In addition to the diminished output, the ability of the kidney to concentrate urea was found to be diminished.[27] No change in blood chemistry was found. The effects of ether were more pronounced in older dogs and in pregnant dogs,[47] and in those with damaged kidneys. No change was found in the urea clearance.[20]

Coller et al [25] studied the renal function during anesthesia by modern clearance methods. They found no change in four of seven patients who received ether. Two showed a decrease in the inulin clearance. In one patient, the decrease persisted for a week postoperatively. This group stated that any changes in the glomerular filtration rate and renal blood flow during operations under ether are probably not due to the primary action of ether on the kidneys but to other factors.

Craig et al [48] found in dogs that the filtration fraction was slightly lower during anesthesia than during control periods in 14 of 18 experiments. The glomerular filtration rate and renal blood flow were below the normal range in seven dogs anesthetized with ether. The glucose Tm was lower under anesthesia in five of seven dogs. None of

44. Martin, R. C.; Livingstone, H., and Wellman, V.: Continuous spinal anesthesia: observations on 1,200 patients. Arch. Surg. **50**:130-136, 1945.

45. Lemmon, W. T., and Hager, H. G., Jr.: Continuous spinal anesthesia; observations on 2,000 cases. Ann. Surg. **120**:129-142, 1944.

19. Loc. cit.

46. Haines, W. H., and Milliken, L. F.: Effect of ether anesthesia on renal function. J. Urol. **17**:147-156, 1927.

27. Loc. cit.

47. MacNider, W. deB.: Consideration of susceptibility and resistance of tissues to general anesthetics. Anesth. & Analg. **14**:97-102, 1935.

20. Loc. cit.

25. Loo. cit.

48. Craig, F. N.; Visscher, F. E., and Houck, C. R.: Renal function in dogs under ether or cyclopropane anesthesia. Am. J. Physiol. **143**:108-118, 1945.

the above findings were changed significantly during light anesthesia. In general, an increase in the depth of anesthesia was accompanied by a marked decrease in the urine flow. It is suggested that the decrease in clearances during deep anesthesia is brought about by constriction of the afferent arterioles. Repeated changes in depth of anesthesia put a strain on the circulation, which in turn affects kidney function.

In rabbits[49] a decrease in both the glomerular filtration rate and renal blood flow was found.

Thus, in some patients and in some animals, there is a decrease in the renal blood flow and in glomerular filtration rate, together with a decrease in the reabsorptive capacity of the tubules. This has not been satisfactorily explained, but differences in depth and duration of anesthesia, in operative procedures, in blood pressure trends, amounts of blood loss, fluid administration, and hypoxia are involved. It is possible that in an ideal condition, with normal kidneys, ether does not precipitate renal damage. The delay in the resumption of urine formation after prolonged deep ether anesthesia may tip the scales against some patients.[18]

2. *Cyclopropane.*—During anesthesia with cyclopropane there seems to be a suppression of renal function, shown by oliguria, followed by a compensatory increase.[50] No change was found in the urea clearance in dogs.[20] Coller et al[25] found that the glomerular filtration rates decreased in their patients who received cyclopropane. The renal blood flow was variable. In one, complete renal failure occurred. The urinary output was low during the first 24 hours postoperatively in spite of large amounts of intravenous and oral fluids. There were no albuminuria, no red cells in the urine, and no evidence of change in reabsorptive capacity of the tubules.

Craig et al[48] found depression of renal blood flow and filtration rate in two animals under cyclopropane.

In view of the foregoing findings, it may be concluded that cyclopropane anesthesia is accompanied by changes in kidney function.

3. *Nitrous oxide.*—Kemp[19] stated that the results which he found with nitrous oxide and oxygen closely paralleled those with asphyxia. There were oliguria and moderate albuminuria. He thought that contraction of renal vessels corresponded with the general circulatory changes. There is usually hypoxia,[51] which renders the filtering membrane more permeable and allows the passage of albumin. If one avoids hypoxia, nitrous oxide anesthesia does not lead to renal damage.

4. *Chloroform.*—Kemp[19] found that the effects of chloroform on renal function varied with the blood pressure. Albuminuria was present only after prolonged narcosis. He reported one death after chloroform with the findings of uremia. Orth and Stutzman[20] found no change in the urea clearance. Beecher [51] stated that there is severe kidney

49. Forster, R. P., and Maes, J. P.: Renal function in the rabbit as influenced by the administration of water, anesthetics and diuretics. Federation Proc. **5**:29, 1946.

18. Loc. cit.

50. Waters, R. M., and Schmidt, E. R.: Cyclopropane anesthesia. J.A.M.A. **103**:975-983, 1934.

20. Loc. cit.

25. Loc. cit.

48. Loc. cit.

19. Loc. cit.

51. Beecher, H. K.: **The Physiology of Anesthesia** (New York: The Oxford University Press, 1940).

20. Loc. cit.

damage with chloroform; there is injury to the tubular epithelium. Chloroform is more toxic to older animals. Adams and Lundy [52] stated that there may be direct damage to the tubular epithelium. The consensus seems to be that kidney damage is of frequent occurrence in chloroform anesthesia.

5. *Ethylene.* —Under ethylene anesthesia there is no oliguria, albuminuria, or diminution in the excretion of phenolsulfonphthalein.[51] No change in the elimination of urea, chloride, or phosphorus has been noted.[32] The chief danger is that of hypoxia.[26] We may conclude that ethylene, properly administered to prevent hypoxia, is not harmful to the kidneys.

6. *Vinethene.*—Orth et al[53] stated there is a progressive decrease in kidney function up to the point of anuria in dogs. Albuminuria is present. The glomeruli are congested, and there is cloudy swelling of the tubular epithelium. Hawk[54] reported the death of a patient after two administrations of vinethene and questions the advisability of either prolonged or repeated administrations of vinethene. Martin and Rovenstine[55] in their clinical evaluation of vinethene stated that it presents a direct and immediate challenge to clinical anesthetists. From the point of view of renal function, vinethene seems a dangerous anesthetic to use, especially for more than a few minutes or for repeated administration.

B. Intravenous anesthetics.—1. *Pentobarbital sodium (nembutal)* is widely used experimentally in anesthetic doses. Corcoran and Page[56] found that the glomerular filtration rate, renal blood flow, and maximal excretory function of the tubules were unaltered in most dogs. However, they found temporary failure of renal function in three of thirty-seven dogs; in these, the filtration rate, renal plasma, and urine flow decreased. These changes were thought to be due to constriction of the afferent arterioles. Selkurt[57] found that the differences in clearances between unanesthetized and anesthetized dogs were not significant. Forster[49] found no change in glomerular filtration rate and in renal plasma flow, in rabbits, after anesthetic doses of pentobarbital sodium. Mylon[58] found the renal function suppressed after pentobarbital sodium; in fact, the effects of this anesthetic were like shock produced in other ways. It seems that this anesthetic cannot be used without caution in experimental work, since there is damage to the kidneys in some of the animals. Fortunately, it is not used as a general anesthetic clinically.

52. Adams, R. C., and Lundy, J. S.: Anesthesia in cases of poor surgical risk; some suggestions for decreasing risk. Surg., Gynec. & Obst. **74**:1011-1019, 1942.

32. Loc. cit.

26. Loc. cit.

53. Orth, O. S.; Slocum, H. C.; Stutzman, J. W., and Meek, W. J.: Studies of vinethene as an anesthetic agent. Anesthesiology **1**:246-260, 1940.

54. Hawk, M. H.; Orth, O. S., and Pohle, F. J.: Hepatorenal syndrome following administration of vinethene. Case report. Anesthesiology **2**:388-392, 1941.

55. Martin, S. J., and Rovenstine, E. A.: Vinethene: recent laboratory and clinical evaluation. Anesthesiology **2**: 285-299, 1941.

56. Corcoran, A. C., and Page, I. H.: Effects of anesthetic dosage of pentobarbital sodium on renal function and blood pressure in dogs. Am. J. Physiol. **140**:234-239, 1943-44.

57. Selkurt, E. E.: Changes in renal clearance following complete ischemia of kidney. Am. J. Physiol. **144**:395-403, 1945.

49. Loc. cit.

58. Mylon, E.; Winternitz, M. C., and de Suto-Nagy, G. J.: Studies on therapy in traumatic shock. Am. J. Physiol. **139**:313-324, 1943.

2. *Pentothal sodium* is extensively used clinically. Tovell[59] found no accumulation of blood urea after the use of pentothal sodium and concluded that the renal function is not disturbed. Silvette[60] found a decrease in urinary output in rats. No clearance studies have been found. Additional work is needed before this anesthetic can be evaluated satisfactorily from the point of view of renal function.

Complications and Their Effects on Renal Function

A. Hypoxia. — Severe anoxic anoxia[61] and anemic, stagnant, and histotoxic anoxia[62] all lead to oliguria or anuria, albuminuria,[52] and lowered phenolsulfonphthalein output. No clearance studies have been found, but in the light of the above findings, it is evident that hypoxia may damage the kidneys.

B. Asphyxia (hypoxia with carbon dioxide retention). — Asphyxia may cause constriction of the renal vessels, with diminished renal blood flow, thereby leading to a decreased production of urine[52] and moderate albuminuria.[19] Carbon dioxide retention may disturb the acid-base condition of the body, and if the kidneys are damaged by the concurrent hypoxia, we may expect them to be unable to aid in restoring normal conditions.

C. Shock.—This is one of the greatest problems encountered in anesthesia. It may be due to any one of many causes, such as hemorrhage, deep anesthesia,[48] long duration of anesthesia, difficult operative procedures, and so forth. The changes in renal function during shock have been studied intensively in the last few years. The effects of shock have been compared with a sudden loss of renal tissues, since for a time the kidney does not get enough blood.[63] Van Slyke et al[64] found that in profound shock the blood flow through the kidneys may be practically stopped. This progresses through the following stages: (1) reduced renal function without damage to nephrons, (2) reversible damage to nephrons, and (3) irreversible damage to nephrons, with death in uremia. This third stage supervenes if renal ischemia has been present for as long as four hours. Lauson et al[65] stated that there is almost complete exclusion of the kidneys from the circulation by means of vasoconstriction; the blood is diverted to the medulla, and the cortex is ischemic.[66] The rate of glomerular filtration and effective renal plasma flow are significantly reduced in nearly every patient suffering from shock.

59. Tovell, R. M., and Thompson, G. J.: Pentothal sodium anesthesia in urologic practice. J. Urol. **36**:81-87, 1936.

60. Silvette, H.: Mechanism of pentothal sodium antidiuresis. Arch. Int. Med. **70**:567-584, 1942.

61. Stickney, J. C.; Northup, D. W., and Van Liere, E. J.: The effect of anoxic anoxia on urine secretion in anesthetized dogs. Am. J. Physiol. **147**: 616-621, 1946.

62. Silvette, H.: Some effects of low barometric pressure on kidney function in the white rat. Am. J. Physiol. **140**:374-386, 1943-44.

52. Loc. cit.

19. Loc. cit.

48. Loc. cit.

63. Addis, T.; Barrett, E.; Lew, W.; Poo, L. J., and Yuen, D. W.: Danger of intravenous injection of protein solutions after sudden loss of renal tissue. Arch. Int. Med. **77**:254-259, 1946.

64. Van Slyke, D.D.; Phillips, R. A.; Hamilton, P. B.; Archibald, R. M.; Dole, V. P., and Emerson, K.: Effect of shock on the kidney. Tr. A. Am. Physicians **58**:119-127, 1944.

65. Lauson, H. D.; Bradley, S. E., and Cournand, A.: Renal circulation in shock. J. Clin. Investigation **23**:381-402, 1944.

66. Corcoran, A. C., and Page, I. H.: Crush syndrome; post-traumatic anuria. J.A.M.A. **134**:436-441, 1947.

The marked reduction in effective renal plasma flow which occurs in shock is out of proportion to the decrease in systemic blood flow.[67] With severe hemorrhage, leading to shock, the renal blood flow and filtration fraction fall to almost zero levels[68]; this indicates maximal constriction of afferent arterioles. A prolonged period of vasoconstriction of renal arterioles follows a period of renal ischemia.[57] Even when the general condition of the patient improves, after therapy, renal failure may cause death in uremia,[65,69] in spite of the return of blood pressure and cardiac output to normal. The increase in vascular resistance in the kidneys in shock has been measured.[70,71]

The kidney normally uses little oxygen,[72] and in shock, when the blood flow is markedly reduced, the kidney uses proportionally less oxygen,[73] instead of more, as is true for most other tissues of the body when the flow of blood decreases. Thus, the condition of the kidney grows worse and worse. Shock is regularly accompanied by severe parenchymatous degeneration. This is characterized by cloudy swelling, edema and petechiae, often progressing to necrosis of the tubular epithelium. There is hyperemia of the glomerular tufts and interlobular vessels.[74]

It is evident that the anesthetist must be constantly on the lookout for shock, since it can do a great deal more damage to the patient than the anesthetic itself.[75]

Summary

The important thing to keep in mind is that there is probably not so much difference in the type of anesthetic used as in the hypoxia or asphyxia which may supervene if not constantly avoided. The patient should be carried in as light a plane as possible; with liberal use of curare for relaxation. Repeated deepening of the anesthetic level may be dangerous. The duration of the anesthesia should be kept as short as possible. With proper premedication less anesthetic agent is needed. Fluid therapy during and after the operation is important in the maintenance of renal fuction. Hemorrhage, change in blood pressure, change in respiration, and shock are only a few of the factors which may complicate the state of anesthesia. A preliminary evaluation of renal function is important, and postoperative observations are informative.

(Continued on page 242)

67. Cournand, A.; Riley, R. L.; Bradley, S. E.; Breed, E. S.; Noble, R. P.; Lauson, H. D.; Gregersen, M. I., and Richards, D. W.: Studies of circulation in clinical shock. Surgery **13**:964-995, 1943.

68. Phillips, R. A.; Dole, V. P.; Hamilton, P. B.; Emerson, K., Jr.; Archibald, R. M., and Van Slyke, D. D.: Effects of acute hemorrhagic and traumatic shock on renal function of dogs. Am. J. Physiol. **145**:314-336, 1945-46.

57. Loc. cit.

65. Loc. cit.

69. Corcoran, A. C., and Page, I. H.: Post-traumatic renal injury; summary of experimental observations. Arch. Surg. **51**:93-101, 1945.

70. Selkurt, E. E.: Renal blood flow and renal clearance during hemorrhagic shock. Am. J. Physiol. **145**:699-709, 1946.

71. Selkurt, E. E.: Relation of renal blood flow to effective arterial pressure in the intact kidney of the dog. Am. J. Physiol. **147**:537-549, 1946.

72. Warren, J. V.; Brannon, E. S., and Merrill, A. J.: Method of obtaining renal venous blood in unanesthetized persons with observations on extraction of oxygen and sodium para-amino hippurate. Science **100**:108-110, 1944.

73. Dole, V. P.; Emerson, K., Jr.; Phillips, R. A.; Hamilton, P., and Van Slyke, D. D.: Renal extraction of oxygen in experimental shock. Am. J. Physiol. **145**:337-345, 1946.

74. Moon, V. H.: Renal deficiency associated with shock. J.A.M.A. **134**:425-429, 1947.

75. Adams, R. C.; Lundy, J. S., and Seldon, T. H.: Shock in relation to anesthetic management. S. Clin. North America **24**:808-813, 1944.

PENTOTHAL SODIUM
Review of Recent Contributions

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The introduction of pentothal sodium as an intravenous anesthetic agent in 1934 by Lundy and Tovell[1] paved the way for the development of a completely new and valuable anesthetic technic. Prior to that time, many agents had been injected intravenously to obtain general narcosis,[2] but in all instances results were discouraging. Ore in 1872 used chloral hydrate. In 1909 Burkhardt used chloroform and ether, and in the same year Bier injected procaine intravenously. In 1913 paraldehyde was used intravenously by Noel. Naragawa used alcohol in 1921, and in 1929 Kirschner injected avertin intravenously. The year 1930 marked a turning point in the use of barbiturates. Nembutal and evipal were the first tried. Finally, in 1934 Lundy published his report on clinical trials with thionembutal, or pentothal. Since then the use of pentothal as an anesthetic agent has become widespread, and World War II probably gave the use of this drug and the intravenous anesthetic technic its greatest impetus.

Actually, the use of pentothal has had its ups and downs in popularity. Its introduction was greeted with great enthusiasm, and many considered it to be the ideal anesthetic agent. This wave of enthusiasm reached its peak with reports on the use of pentothal for all types of surgery including major abdominal operations. The placing of such responsibility on the not too potent agent pentothal resulted in many disappointments and in unnecessary complications. The disadvantages of pentothal became apparent, and a wave of skepticism concerning the value of the drug followed.

This was particularly true after the disastrous results at Pearl Harbor[3] and again during the North African campaign.[4] However, the problem was thoroughly investigated in both the laboratory and the clinic, and in the armed forces many restrictions were placed on the use of the drug. With the development of caution and respect for the power of pentothal in 1943, the drug soon came to assume its proper place as one of the more valuable agents in the armamentarium of the trained anesthetist.[5]

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1. Lundy, J. S., and Tovell, R. M.: Annual report for 1934 of section on anesthesia; including data on blood transfusion. Proc. Staff Meet., Mayo Clin. **10**:257, 1935.

2. Keys, T. E.: **The History of Surgical Anesthesia** (New York: Henry Schuman, 1945).

3. King, Edgar: The treatment of army casualties in Hawaii. Army M. Bull. **61**:18, April, 1942.

4. Rankin, F. W.: Sodium pentothal anesthesia. Letter and Bulletin, U.S. Army Medical Depot, Mar. 21, 1944.

5. Adams, R. C.: **Intravenous Anesthesia** (New York: Paul B. Hoeber, Inc., 1944).

In this discussion it will be possible to review only a few of the more significant articles recently published. Before proceeding, however, it is necessary to warn against the use of pentothal by the injudicious or the overconfident. It is a dangerous drug. Once given, it cannot be reclaimed or withdrawn from the blood stream by the administrator. However, there are two safety factors, or, perhaps we should say, two requirements, to the use of pentothal sodium: (1) the ability of the administrator to perform intratracheal intubation quickly, expertly, and efficiently and to carry out artificial respiration in accordance with the principles of respiratory physiology; (2) the presence of a trained physician or anesthesiologist experienced in both cardiovascular and respiratory resuscitation.

With regard to the concept of intravenous pentothal sodium anesthesia, it should be stated at the outset that it is not a form of anesthesia different from anesthesia produced by inhalation of anesthetic agents, usually referred to as general anesthesia. Actually, the intravenous administration of anesthetic agents is just another means of producing general anesthesia. All narcotics, regardless of the route of administration, are taken into the blood stream and by this channel reach the brain. Bearing this in mind, it becomes easy to comprehend, for instance, the signs of anesthetic depth as manifested by a patient under pentothal sodium narcosis.

Recently, Etsten and Himwich[6] did some outstanding work on the segmental levels of the brain affected by pentothal and the order in which the different centers of function are influenced. On the basis of their experimental results, they explained the stages of anesthesia on a physiologic basis. First they described the five chief anatomic areas, or segments, of the brain which have been acquired by man in his embryologic development. These five areas have been called the phyletic areas and correspond to five levels of function. The first and oldest area is the medulla in which purely automatic activity, such as that concerned with respiration and circulation, resides. The second area is the pontine area, and the third is the midbrain in which the centers for specialized sensory and motor nerves are located. The fourth is the diencephalon in which there is some organization of sensation and motor activity and a primitive integration of these functions on the instinctive level. The fifth area is the cerebral cortex in which all activities are highly integrated, and in which association, interpretation, and activity are on the conscious level. The cortex is the most recently acquired part of the brain, is the most highly developed, and, being quite delicate, reacts quickly to stimulants or depressants or is readily injured by noxious agents.

By studying the oxygen consumption at these levels with the subject under pentothal anesthesia, Etsten demonstrated that there is a descending depression of cerebral oxidation, the medullary centers being the last to be inhibited; when this occurs, both respiratory arrest and cardiovascular depression occur, the resulting state corresponding to stage IV of Guedel. The sequence of events leading to this stage —loss of consciousness, a dream state,

6. Etsten, B., and Himwich, H. E.: Stages and signs of pentothal anesthesia: Physiologic basis. Anesthesiology 7:536-548, Sept., 1946.

constriction of the pupils, loss of eyeball activity, loss of pharyngeal reflex, loss of response to cutaneous pain, loss of laryngeal reflex, and later loss of traction reflexes—corresponds to Guedel's classification of signs seen under ether anesthesia. That this sequence can occur in pentothal anesthesia, however, does not necessarily mean that it is safe or wise to achieve such depth with this drug. Actually, pentothal should be regarded as an impotent drug for obtaining planes iii and iv of stage III; these depths are obtained only when doses which may be considered toxic are administered.

Administration and Technics

With regard to administration and technics, a few comments about venipuncture are in order. Adams[7] recently wrote on this subject, and his comments deserve reading. Suffice it to say that in selecting a vein those on the back of the hand and those on the dorsum of the foot should not be overlooked. After a tourniquet is applied, several seconds should be allowed for adequate filling. The needle may be inserted in one maneuver or in two steps, i.e., it may be inserted through the skin and subcutaneous tissues for a few centimeters and then into the vein. For the best results, the bevel of the needle should be down; if this is done, there will be fewer instances of penetration of the opposite vein wall with resultant hematoma.

If the venipuncture is poor and a hematoma develops, leaving a tourniquet in place only increases the size of the hematoma. The tourniquet should be removed and firm pressure applied for four or five minutes over the area of puncture; massage may be helpful. If this procedure is followed, the vein may be used again.

Technically, pentothal sodium anesthesia has had three phases of development. When it was first introduced, only air was breathed by the patient, and pentothal was used for short procedures. In 1938 Carraway[8,9] reported his experiences with the use of oxygen given continuously by nasal catheter during intravenous anesthesia and showed that longer anesthesia could be obtained with a given dose, that muscular relaxation was enhanced, and that toxic reactions were minimized.

A few years later a third phase began with the introduction by Lundy[10] of nitrous oxide-oxygen mixtures in combination with pentothal. Since then other combinations have been added, such as pentothal and regional anesthesia,[11] intravenous pentothal anesthesia with spinal anesthesia,[12] and pentothal-nitrous oxide-oxygen with curare.[13] Since 1940 many ingenious mechanical gadgets have been introduced for administering pentothal, but all are complex and tend to undermine one of the chief advantages of pentothal anesthesia, namely, the simplicity of

7. Adams, R. C.: Venipuncture—neglected subject. S. Clin. North America **25**:792-794, Aug., 1945.

8. Carraway, B. M., and Carraway, C. V.: Intravenous anesthesia: A clinical study of 1,900 cases. Am. J. Surg. **39**:576, 1938.

9. Carraway, B. M.: Pentothal sodium with nasal oxygen: A report of 3,180 consecutive cases. Anesth. & Analg. **18**:259-269, Sept.-Oct., 1939.

10. Lundy, J. S., and Tuohy, E. B.: Newer trends in intravenous anesthesia. Minnesota Med. **26**:349-353, 1943.

11. Tuohy, E. B.: Clinical use of intravenous anesthesia alone and in combination with other anesthetics: A method of anesthesia eliminating the hazards of fire and explosion. South. M.J. **34**:42-45, Jan., 1941.

12. Hand, L. V., and Sise, L. F.: Intravenous agents as supplementary anesthesia. Bull. Lahey Clin. **1**:18-21, Mar., 1939.

13. Brody, J.: The use of curare in sodium pentothal-nitrous oxide anesthesia. Anesthesiology **6**:381, July, 1945.

equipment required for administration, that is, the needle and the syringe. Actually, there are three modifications that are useful yet simple: (1) a short piece of connecting tubing with syringe and needle; (2) a three-way stopcock for longer procedures, saline being administered through one opening and pentothal being injected intermittently through the other; (3) the ordinary infusion set for the continuous administration of highly dilute solutions.

Concentrations

The strengths of pentothal solutions currently in use are the 2½ per cent originally recommended by Lundy, the 5 per cent solution useful for induction, the 1 per cent solution administered by drip for surgical procedures (an initial rapid drop rate being used for induction and a slow rate of maintenance[14]), and highly dilute solutions, such as 1:1,000 as introduced by Lenowitz[15] for sedation and narcosis, particularly as a supplement to spinal and local anesthesia.

Duration of Anesthesia and Dosage of Drug

Until recently it was considered inadvisable to administer pentothal for operations lasting more than an hour or to give more than 1 Gm. pentothal to a patient. However, these limitations have been exceeded: many prolonged operations have been done under pentothal, and much more than 1 Gm. has been given to a patient during an operation. This departure from one of the original principles established by Lundy obviously implies strict observance of the principles of anesthesia. For a series of patients with maxillofacial injuries undergoing reconstructive surgery, intravenous pentothal anesthesia with the use of an intratracheal airway was the anesthesia of choice.[16] Generally 1.5-3 Gm. pentothal was administered without untoward results. Several patients received more than 3 Gm., and one patient received 4.8 Gm. Fourteen operations lasted more than three and one-half hours, and six lasted from four to six hours.

It was noted that with an increase in the duration of anesthesia the amount of drug required to keep a patient in a state of surgical anesthesia became less (figure). Although about 1.5 Gm. was used for the average three-quarters to one hour surgical procedure, only 2 Gm. was required for the average two and one-half hour procedure, while approximately 3 Gm. was needed for the five to six hour operation. Thus, as the duration of the operation is extended, less drug is needed per unit of time. These figures support the idea that as pentothal anesthesia becomes prolonged, the drug more and more resembles the short acting barbiturates such as seconal and nembutal.

Rectal Anesthesia

In the reports by Weinstein[17,18] and the unpublished work of Burdick,[19] the

14. Narat, J. K., and Giraldi, E.: Intravenous anesthesia in major surgery. Am. J. Surg. **64**:178-181, Nov., 1944.

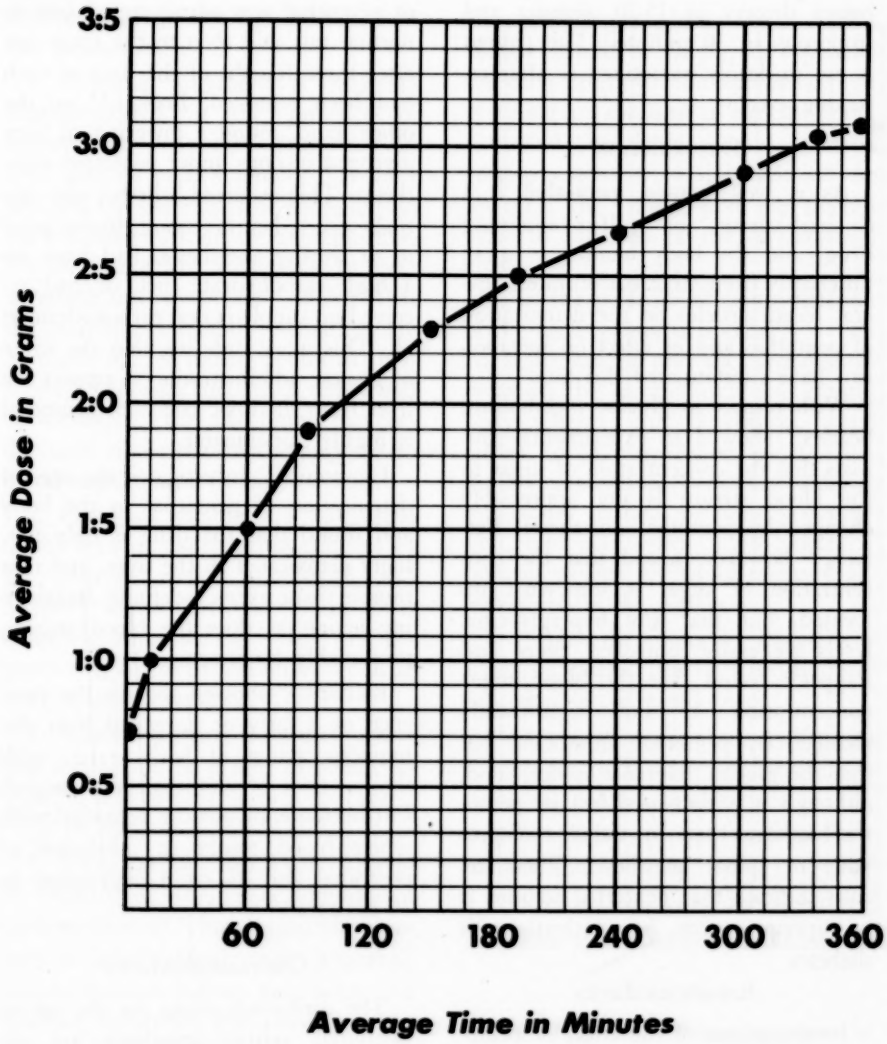
15. Lenowitz, H.; Lipson, H. I., and Stevens, E. J.: High dilution pentothal sodium for sedation, narcosis and anesthesia. Anesth. & Analg. **23**:78-91, Mar.-April, 1944.

16. Collins, V. J.: Endotracheal anesthesia under sodium pentothal for maxillofacial surgery. Anesthesiology, to be published.

17. Weinstein, M. L.: Rectal pentothal sodium: A new pre- and basal anesthetic drug in the practice of surgery. Anesth. & Analg. **18**:205-209, July-Aug., 1939.

18. Weinstein, M. L., and Light, G. A.: Basal anesthesia with pentothal sodium. Anesth. & Analg. **22**:68-80, Mar.-April, 1943.

19. Burdick, D. L.: Personal communication to the author.



Relationship between average time and dose in 48 pentothal sodium anesthetics given for maxillofacial surgery.

rectal administration of pentothal has been shown to be a valuable procedure. It is applicable to both children and adults. The dose is 1 Gm. per 50 pounds, and each gram is dissolved in about 30 cc. water. Prior to the administration of the anesthetic, the patient's rectum should be cleansed. It is imperative that soapsuds solution should not be used; this solution is alkaline, and any residuum will react with the more acid pentothal and nullify its anesthetic effect. Saline solution is recommended for the cleansing enema. Morphine-scopolamine combination should be given as premedication from 30 to 60 minutes prior to the rectal instillation. After instillation the patient be-

comes drowsy in 15-20 minutes and stuporous in 30 minutes. The patient is not so deeply narcotized as after receiving avertin.

Detoxication

As is well known, pentothal is a thiobarbiturate, or sulfur-containing drug, and the body handles it quite differently from other barbiturates. Several recent articles on the detoxication of pentothal and its effect on metabolism have substantiated this fact.

With respect to glucose metabolism, Searles[20] showed in experimental animals that the concentration of sugar in the blood stream is not appreciably changed by pentothal anesthesia. Betlach,[21] however, found that the concentration of sugar is somewhat increased, but that any hyperglycemic levels are easily controlled. Stern and Papper[22] found that the blood sugar concentration is not significantly changed by pentothal anesthesia, but that the glucose tolerance is decreased, although it is decreased less by pentothal sodium than by either cyclopropane or spinal anesthesia. These results indicate that pentothal sodium is a superior agent for patients with diabetes.

Effect on Liver

Investigations of the effect of pentothal sodium on the liver indicate that the liver may be of little importance in the metabolism of pentothal. Scheifley[23] found little difference in the duration of anesthesia when a given dose of pentothal was administered first to normal rats and then to the same rats after three fourths of the liver of each had been removed. Booker,[24] on the other hand, found a lowering of liver glycogen in dogs under pentothal anesthesia. This occurred whether the animals received intravenous glucose prior to or during anesthesia, had been on a high carbohydrate diet, or had received no supplemental carbohydrate at all. This work indicates that the value of glucose administration to protect the liver from the toxic effects of pentothal is highly questionable.

Delmonico[25] investigated the sites of detoxication of pentothal in the body and found that the drug is only partially detoxicated in the liver, and that muscle tissue exerts a definite detoxicating action as does the blood stream, presumably by enzymes.

Richards[26] showed that in the presence of a fatty or damaged liver the hypnotic action of barbiturates, with the exception of pentothal, is prolonged. Furthermore, incubating pentothal with whole blood results in inhibition of pentothal and its rapid destruction in 30 minutes.[27]

Contraindications

The contraindications for the use of pentothal sodium anesthesia are un-

20. Searles, cited by Adams, R. C.: **Intravenous Anesthesia** (New York: Paul B. Hoeber, Inc., 1944).

21. Betlach, cited by Adams, R. C.: **Intravenous Anesthesia** (New York: Paul B. Hoeber, Inc., 1944).

22. Stern, M.; Papper, E. M.; Beuding, E., and Rovenstine, E. A.: The effects of anesthesia on glucose tolerance. J. Pharmacol. & Exper. Therap. **34**:157-159, June, 1945.

23. Scheifley, C.: Pentothal sodium—its use in the presence of hepatic disease. Anesthesiology **7**:263-267, May, 1946.

24. Booker, W. M.: Observations on the carbohydrate metabolism during prolonged pentothal anesthesia in dogs. The blood sugar and liver glycogen. Anesthesiology **7**:405-415, July, 1946.

25. Delmonico, cited by Adams, R. C.: **Intravenous Anesthesia** (New York: Paul B. Hoeber, Inc., 1944).

26. Richards, R. K.: Bellevue Hospital Anesthesiology Staff Conference, May, 1947.

27. Richards, R. K.: Inactivation of pentothal. Anesthesiology **8**:90-91, Jan., 1947.

doubtedly of greater significance than the indications.

1. Pentothal anesthesia is definitely contraindicated in the presence of hemorrhage or shock. Burstein[28] in 1943 showed experimentally that after hemorrhage the effects of pentothal on the circulatory system are unpredictable, but in general are deleterious. In 1945 Zweifach and co-workers[29] showed that the peripheral circulatory dynamics are markedly altered during pentothal anesthesia when associated with shock and hemorrhage. They also found that under such circumstances the response to blood replacement therapy is poor.

2. Pentothal anesthesia is dangerous to the fetus if used during delivery or for cesarean section. Dreisbach and Snyder[30] found that fetal respiration is definitely depressed and that this depression is a direct function of the drug and its concentrations.

3. When relaxation is needed, pentothal should not be given; to obtain relaxation a supplement, such as curare, must be used.

4. When potent reflexes are likely to be initiated or stimulated, pentothal is contraindicated. Thus, even when curare is administered with pentothal, various traction reflexes may occur and produce respiratory and circulatory depression, either by central action or via the autonomic nervous system. For example, when pentothal is used for oto-laryngologic procedures, local cocainization should be employed, especially for bronchoscopy. The anesthesiologist planning to intubate a patient under pentothal anesthesia should likewise employ extensive cocainization of the pharynx, the larynx, and the trachea prior to insertion of the intratracheal airway.

5. In the presence of acute infection of the neck, pentothal should be avoided. Inflammation near the carotid sinus depresses the carotid sinus and carotid body reflexes; this depression, when added to the depression of the medullary centers by pentothal sodium, may result in fatal respiratory depression, especially when high concentrations of oxygen are simultaneously administered to the patient.

6. In chronic pulmonary disease and advanced cardiac disease with dyspnea, pentothal is contraindicated.

However, there are three undisputed advantages to the use of intravenous pentothal sodium anesthesia[5]:

1. Simplicity of equipment and administration
2. Nonexplosibility of the agent
3. Ease and rapidity of induction

COMPLICATIONS

The well known complications of apnea and laryngospasm have been observed by all of us. Spraying the pharynx and larynx with cocaine or the administration of atropine, gr. 1/75, will usually overcome laryngospasm due to the drug. If the laryngospasm is due to reflexes, the stimulus must be removed. Laryngospasm may also be avoided by allowing at least 5-10 minutes to elapse after the time of induction before the operation is begun.

28. Burstein, C. S., and Hershey, S. G.: Circulatory effects from sodium pentothal administered soon after hemorrhage. Proc. Soc. Exper. Biol. & Med. **53**: 80-81, May, 1943.

29. Zweifach, B. W., Hershey, S. G.; Rovenstein, E. A.; Lee, R. E., and Chambers, R.: Anesthetic agents as factors in circulatory reactions induced by hemorrhage. Surgery **19**:48-65, July, 1945.

30. Dreisbach, R., and Snyder, F.: The effect on the fetus of pentobarbital sodium and pentothal sodium. J. Pharmacol. & Exper. Therap. **79**:250-258, Nov., 1943.

5. Loc. cit.

Tissue slough from extravascular infiltration of pentothal, especially a 5 per cent solution, can be prevented by injection of the area with 1 per cent procaine, as shown by Elder.[31]

Hiccupping, sneezing, and coughing have been encountered during pentothal anesthesia, and these complications may be combated by the administration of atropine, by spraying the nose, throat, and larynx, and by changing the anesthetic agent. In addition, hiccupping can be relieved by increasing the CO_2 content through rebreathing, by the administration of curare, and by blocking the phrenic nerves.

In the treament of overdosage, the most important procedure is to provide a patent and adequate airway through which oxygen can be administered and artificial respiration efficiently performed.

With regard to analeptics, Mousel and Essex,[32] after experimental studies, concluded that most are of doubtful value. Schmidt[33] showed that the injection of analeptics when the respiratory center has been depressed by drugs accompanied by hypoxia only further depresses the respiratory center by causing cellular fatigue. However, two drugs do seem to have some value once adequate oxygenation has been instituted. These are metrazol and picrotoxin. Pickrell and Richards[34] showed that there is some antagonism between pentothal and metrazol and that recovery from pentothal anesthesia is shortened by the use of metrazol. The dose of metrazol varies from 1 to 10 cc. of a 10 per cent solution given intravenously until muscle twitches appear, usually about the face and eyes. Picrotoxin, likewise, has been shown by Burdick[35] to be of value in barbiturate poisoning. The dose schedule recommended is 1 mg. per minute for 15 minutes, or until twitches appear.

A third chemical, not an analeptic per se, namely, sodium succinate, seems to be of some use in the detoxication of pentothal. This substance is intimately related to various enzyme systems of the body and may act as a respiratory catalyst aiding release of available oxygen. A 30 per cent solution of hydrated sodium succinate is used, and the dose is from 2 to 100 cc. given intravenously.[36]

Lastly, one must not overlook nutrition and fluid balance in cases of overdosage in which recovery is prolonged. Fluids may be given intravenously, alimentation may be forced, and the administration of liquid mixtures by stomach tube may be instituted. At the same time, excretory requirements must be met; for example, the patient should be catheterized about three times a day.

Summary

Salient features in the development of intravenous anesthesia have been presented. In particular, some recent contributions on the use of pentothal sodium as an intravenous agent have

(Continued on page 224)

31. Elder, C. K., and Harrison, E. M.: Pentothal sodium slough-prevention with procaine. J.A.M.A. **125**:116-117, May, 1944.

32. Mousel, L. H., and Essex, H. E.: An experimental study of the effects of respiratory stimulants in animals under pentothal sodium anesthesia. Anesthesiology **2**:272-280, May, 1941.

33. Schmidt, Carl: The influence of cerebral blood flow on respiration. Am. J. Physiol. **84**:202-242, Feb., 1928.

34. Pickrell, L. L., and Richards, R. K.: Pentothal metrazol antagonism. Ann. Surg. **121**:495-507, April, 1945.

35. Burdick, D. L., and Rovenstine, E. A.: Picrotoxin in barbiturate poisoning. Ann. Int. Med. **22**:819-826, June, 1945.

36. Barrett, R. K.: The analeptic effect of sodium succinate on barbiturate depression in man. Anesth. & Analg. **26**:74-81, March-April, 1947.

EVALUATION OF ANESTHETIC RISK

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It is impossible to evaluate anesthetic risk and surgical risk separately because the operation is performed and the anesthesia conducted simultaneously. An operation performed under anesthesia subjects the patient to the harmful effects of a toxic agent, used to prevent pain and to promote muscular relaxation, plus the trauma and blood loss incident to the cutting, dissecting, and suturing of tissues. It must not be forgotten that the analgesia attained by the use of anesthetic agents is due to their toxic effects upon the central nervous system, nerve roots, and peripheral nerves, and that, no matter how beneficent the anticipated results of surgery may be, the immediate physiologic effect of surgery is always harmful. Again, when an operation is performed under anesthesia, more occurs than the mere superposition of the separate harmful effects of the surgical procedure on the one hand and of the anesthetic agent on the other; for in certain instances anesthesia and surgery may exert the same harmful physiologic effects. For example, an anesthetic agent may cause the blood pressure to fall; blood loss and trauma may do the same. An anesthetic may cause the heart muscle to become abnormally irritable and may predispose to the development of ventricular fibrillation; operations which involve the handling of certain large nerves may do the same. An anesthetic may depress respiration and interfere with oxygen exchange in the lungs; operations on the chest may cause a sudden marked decrease in respiratory exchange. An anesthetic agent may exert harmful effects upon the liver; a surgical procedure in which the gallbladder or bile passages are involved may do the same.

In general, therefore, it may be said that the better the surgical risk, the better the anesthetic risk, and vice versa. More specifically, the better the general condition of the patient, the better the status of his circulation, his respiration, and his kidney and liver function, and the less traumatic and prolonged the operation, the better the anesthetic risk.

For the purpose of this discussion, however, it is permissible to consider an evaluation of the *additional* anesthetic risk, that is, the risk of superimposing the administration of an anesthetic upon a given surgical procedure. For the most part, but not entirely, this is a short term risk that exists only during the operation and for a short time before and after. This is true because in most instances the duration of the toxic effects of anesthetics is short, measured in hours rather than in days. On the contrary, the risk of surgery is of longer term, since the trauma of an operation may be followed by late sequelae, such as hemorrhage, infection, ileus, atelectasis, and thromboembolism.

Read before the Institute for Nurse Anesthetists, New Orleans, May 29, 1947.

*Professor of Medicine, Louisiana State University.

The following considerations are related to an evaluation of this additional anesthetic risk, although many of them also apply to surgical risk.

1. A person in good general condition, who looks well, who has a normal blood pressure and hemoglobin, and in whom there are no evidences of disease of the heart, lungs, liver, or kidneys is a good anesthetic risk and may be expected to survive the administration of any of the generally used anesthetics.

The more active a person has been and the more adequate his diet during the days preceding the operation, the better his general condition, and the better the risk. Prolonged periods of bed rest preceding an operation, especially for the aged, and dietary restrictions for more than a few days definitely increase the risk. I do not know for sure whether very early postoperative ambulation is advisable, but I am quite certain that preoperative ambulation greatly decreases the risk of elective surgery.

2. A person in poor general condition who does not look well, even though he may have a normal blood pressure and hemoglobin and no evident disease of the vital organs, is a poorer risk. For such a person, one should avoid using anesthetics which are likely to lower the blood pressure, such as spinal anesthetics, or to depress respiration, such as pentothal sodium, or which must be given with low concentrations of oxygen in order to obtain sufficient relaxation, such as nitrous oxide and, for some operations, ethylene. Generally a patient in this group is a good risk for ether or cyclopropane.

3. A person with *hypertension* but with no evident disease of the vital organs is, in general, a good risk for all anesthetics except spinal. A sudden drop in blood pressure may produce dire effects in such a person.

4. A person with *low blood pressure* that is not due to shock or hemorrhage but rather to constitutional make-up and who is in good condition is a good risk for anesthesia. However, spinal anesthetics should be avoided.

5. *Anemia* of more than slight degree, i.e., hemoglobin below 10 Gm. or 60 per cent, definitely increases the operative risk because it diminishes the ability of the blood to transport oxygen to the tissues. Except in dire emergencies, the hemoglobin should be raised above 10 Gm. by transfusion before an anesthetic is given. Anesthetic agents which depress respiration or lower blood pressure should not be administered to a patient with anemia.

6. A patient with *organic heart disease,* with or without enlargement of the heart, but in whom there are no signs of cardiac decompensation is, as a rule, a good risk for anesthesia with ether or with ethylene-oxygen provided the concentration of oxygen in the mixture is not reduced below that of the atmosphere, i.e., 20 per cent. Cyclopropane is best avoided in these cases because it may cause the heart muscle to become abnormally irritable; cyclopropane should especially be avoided if the rhythm of the heart is irregular or if the patient has been digitalized before the operation. Spinal anesthesia is also contraindicated, especially for patients with disease of the valves or disease of the coronary arteries, because in both instances a drop in blood pressure may seriously compromise the coronary circulation.

7. A person with congestive heart failure and a person who has had a

coronary occlusion within two months are poor risks for anesthesia and surgery, and only emergency surgical procedures should be performed on these patients. Ether-oxygen is by far the least dangerous anesthetic for them, unless the operation can be performed under local anesthesia without injecting large amounts of the local anesthetic agent. After these patients recover from heart failure or coronary thrombosis, they are reasonably good risks.

8. A person with *chronic disease of the lungs* is a good risk provided the disease has not significantly reduced respiratory function. In general it may be said that if the patient is not short of breath after ordinary effort, he may be considered a good risk for surgery not involving the thorax. However, operations which involve collapsing the chest wall or opening the thoracic cavity should not be undertaken without prior evaluation of lung function by definitive methods, it being especially important to know the relative amount of ventilation and oxygen absorption accomplished by each lung. In these cases, agents which depress respiration or lower blood pressure should be avoided, a clear airway must be maintained, and the concentration of oxygen in the anesthetic mixture must never be reduced below that of the atmosphere. The best anesthetics for these patients are cyclopropane and ether. Irritation of the mucous membranes of the respiratory tract is not of great moment, even when ether is used. Anesthesia and surgery should be avoided in a patient with acute pulmonary or bronchial disease except in an emergency; for such a patient cyclopropane would probably be the best agent if local anesthesia were not feasible.

9. A patient with *kidney disease* is a good anesthetic risk provided there are no significant retention of urinary constituents in the blood, as indicated by an elevation of nonprotein nitrogen and urea, and no edema. Spinal anesthesia should not be used, because a drop in blood pressure, even temporary, may cause diminution of blood flow through the kidneys with resultant decrease in the output of urine, which may precipitate the onset of uremia in the postoperative period. A patient with acute nephritis and a patient with edema due to subacute or chronic nephritis are not good risks, and elective operations should not be performed on them.

10. A patient with *liver disease* or *jaundice* due to obstruction of the biliary tract is usually a good anesthetic risk, but not necessarily a good surgical risk, provided his general condition is satisfactory. Pentothal sodium, which is detoxified principally in the liver, should never be used for such a patient, and it is also best to avoid ether, which possesses some hepatoxic properties. Cyclopropane, ethylene, or spinal anesthetics are acceptable anesthetics for such a patient.

11. The chances that a patient with *hyperthyroidism* will survive the anesthesia and the operation are always uncertain unless the hyperthyroid state has been completely controlled before the patient is subjected to an operation. This can now be accomplished in practically all cases by the administration of antithyroid drugs, such as thiouracil and propylthiouracil. In the past, a large percentage of deaths on the operating table occurred in this group of patients. The patient is a poor risk unless in the immediate preoperative period he shows

a gain in weight, a lowering of the pulse rate, and a progressive decline in the basal metabolic rate. Cyclopropane is a dangerous anesthetic for these patients because the heart muscle is already hyperirritable. A free airway is important, and for this reason intratracheal anesthesia is to be preferred.

Summary

Anesthetic risk and surgical risk are inseparable factors, since the anesthesia must be conducted and the operation performed simultaneously. Both anesthesia and surgery are actually, as well as potentially, harmful, and both must be employed so as to minimize the harmful effects of each while an attempt is made to attain the hoped-for benefits of the surgical procedure. In most cases the risk of surgery is greater than the risk of anesthesia. Anesthetic risk relates principally to those cases in which the harmful pharmacologic effects of the anesthetic agent combine with physiologic disturbances that actually or potentially exist in the patient to produce serious or fatal consequences. The principal harmful pharmacologic effects of anesthetics are depression of respiration, lowering of blood pressure, and increase in irritability of the heart muscle. The roles which may be played by these effects in persons with hypertension, hypotension, anemia, and disease of the heart, lungs, kidneys, liver, and thyroid gland have been discussed. The greater the number of vital organs involved by disease and the more extensive the involvement, the greater the risk of anesthesia and of surgery. However, an appraisal of the general condition of the patient—how he looks, how he feels, how alert he is, how good his muscle tone is — furnishes the best evaluation of anesthetic risk.

TRENDS

(Continued from page 199)

The figures in the table, in addition to showing trends as to percentage of articles in foreign languages and yearly totals, show that, while the total output of literature on anesthesia during the war years was reduced, the percentage of the total articles that were in English increased from 1935 to 1944 and decreased during 1945 and 1946. Articles in foreign languages declined from 1939 to 1942 and have increased each year since then.

From an admittedly limited comparison of the clinical use of anesthetics with the literature it appears that there is no true relationship. The literature which is now being printed may be the only record which will remain. Will the picture which that record conveys be an accurate portrayal of the practice of anesthesia as it is today?

No positive conclusions have been drawn from this study. It may be that the patterns and the questions raised will be of interest to others who, like the authors, have wondered "What are the trends in anesthesia?"

PENTOTHAL SODIUM

(Continued from page 220)

been reviewed. It has been emphasized that the intravenous administration of drugs is merely another way of obtaining "general anesthesia." Attention has been directed to significant reports dealing with administration and technics; concentrations of pentothal sodium in current use; rectal administration of pentothal sodium; detoxication; effect on the liver; contraindications; complications and overdosage.

ANESTHESIA FOR OBSTETRICS

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In many, otherwise modern, hospitals, anesthesia is considered unimportant in the obstetric department. Obstetric patients are anesthetized by nurses who have had no training in anesthesia. The agents generally used are ether, chloroform, and various forms of rectal analgesics. In many of these hospitals, on the other hand, a surgical patient submitting to the most minor operation is safeguarded in every way with respect to anesthesia. The anesthetist must be a nurse who has completed a course in a recognized school. The anesthetic drugs must be the safest and the most pain relieving available. Fortunately, the best trained and most progressive obstetricians are demanding the same consideration for their obstetric patients that surgeons are demanding for their surgical patients. This demand is bringing about a decided improvement in the attitude of hospitals toward the obstetric department, especially with respect to anesthesia. The anesthetist is being required to give anesthetics that will make working conditions as favorable as possible for the obstetrician and that will also safeguard the lives of the mother and baby.

Anesthetic Equipment

An anesthetic machine that can deliver oxygen, ether, and the various anesthetic gases is as important in the delivery room as it is in the operating room. The inhalation anesthetics generally used are nitrous oxide and ether, ethylene, and cyclopropane. Few obstetricians now ask for chloroform. An aspirator is also a necessity in the practice of safe obstetric anesthesia. Frequently patients are admitted with undigested food in their stomachs. When labor starts, digestion stops. Anesthesia for these patients is risky, particularly if a good aspirator is not quickly obtainable. Should vomiting occur and vomitus get in the patient's eyes, the eyes should be washed thoroughly to prevent their being injured by the action of the gastric juices. Equipment for giving oxygen to babies is also essential. Often babies react strongly to the sedation given the mother and are born sleepy. They readily respond to oxygen. Occasionally, hard rubber intratracheal catheters are used to remove secretions while the baby is being resuscitated, and a supply of sterile catheters should be available. They are often the means of saving a baby's life. It is absolutely necessary that the anesthetist should know the obstetrician's technics and have available, at all times, the equipment he will need.

Danger Signs

During labor, a reliable sign of impending danger to the infant is a marked change in the fetal heart tones.

Read before the Tenth Annual Meeting of the Southeastern Assembly of Nurse Anesthetists, Biloxi, Miss., April 10, 1947.

A rate of 175 or above is a sign of danger. A slowing of the fetal heart tones to less than 100 per minute also indicates distress. In either instance oxygen should be given intranasally to the mother; this will fortify the baby until delivery is accomplished.

Sedatives

Various sedatives and analgesics are used to make the patient drowsy so that she will sleep between contractions. Many times they completely block out the memory of labor. When such drugs have been given, less anesthetic gas is needed at the time of delivery, especially if no operative procedure is indicated. The most disturbing feature of heavy sedation is asphyxia in the newborn. Some obstetricians give ephedrine sulfate to the mother when administration of the anesthetic is begun. When this is done, the baby cries almost immediately after birth. However, if cyclopropane is used, ephedrine sulfate is contraindicated. Almost all analgesics depress the respiratory center of the baby's brain. Unless respiration is established within a reasonable time, permanent damage may result from complete or partial asphyxia. The question has also arisen as to whether the free administration of barbiturates and other analgesic agents can cause intrauterine death of the fetus.

The barbiturates, if given near the time of delivery, produce relatively severe anoxia by depressing respiration and reducing cellular respiration; this is especially true in the brain. It has been demonstrated that anoxia may produce various pathologic changes in the central nervous system. When barbiturates are given alone or are combined with morphine or scopolamine, the infant is born sleepy or even semicomatose. It may gasp, but it soon falls asleep, and its respirations are shallow. Sometimes three to ten minutes may elapse before the baby can cry vigorously. The stupor may last for several hours. Often the baby does not nurse well. It is generally conceded that morphine may be given up to four hours before birth, but not after that time. The problem in this instance is the unknown time of delivery. The exact time cannot be predicted, even by the best obstetricians.

Asphyxia

An understanding of the true significance of asphyxia is particularly important in anesthesia for obstetrics. If respiration is not established in 30 seconds, the infant has been affected by strangulation, anesthesia, narcosis, or shock resulting from traumatic labor.

There are two types of asphyxia: asphyxia livida and asphyxia pallida. The type depends upon the degree of anoxia. The signs of asphyxia livida are cyanosis, swelling, and congestion of the face, open eyes, pallor around the nose and mouth, and blue lips. Muscle tone is poor, the body is rigid, and the arms are extended upward. The throat reacts to stimulation, and the mouth will close when a finger is inserted. The heart and cord pulsate strongly but slowly. If the respiratory passages are cleared and oxygen and artificial respiration given, the infant will breathe in a short time. In asphyxia pallida, muscle tone is poor, the body is limp, and the extremities hang down. The throat does not react to stimulation, and the relaxed jaw drops. Respiratory movements are absent except for occasional gasps. The heart beat is weak, and the

cord does not pulsate. This condition indicates severe anoxia, and the prognosis is grave. The cause is excessive or prolonged pressure on the brain, acute anemia, apnea, morphine poisoning, or cyclopropane poisoning. Nicotinamide, 100 mg. with each does of sedation, or 150 mg. given intravenously when the mother is taken to the delivery room, will counteract the depressing effect of cyclopropane on the respiratory center of the newborn.

Symptoms of postnatal apnea are slightly cyanotic lips and light grayish blue skin. The features are normal, and the heart beat is strong. If mucus and fluid are removed from the air passages, respirations will take place. Atelectasis, poor aeration, and spontaneous pneumothorax may also occur. The asphyxiated infant may develop bronchopneumonia, icterus, infection, or hemorrhage into the parathyroid glands with spasmophilia and meningitis. Cerebral hemorrhage may result in idiocy or spastic paralysis. Severe methods of resuscitation may also be injurious.

Blood Pressure

A severe fall in the mother's blood pressure before and during delivery will cause severe anoxia in the infant. The infant soon dies if the mother's blood pressure falls to zero. Immediate delivery is necessary, or the baby will be born dead. If the mother is in shock, a high percentage of oxygen and just enough gas to numb sensation should be given. Mothers should be given plasma as soon as they show signs of impending shock. If a traumatic delivery is expected, fluid administration should be started soon after administration of the anesthetic is begun. The solution should drip slowly to prevent lung saturation.

Brain Cells Sensitive to Lack of Oxygen

Devastating pathologic changes are produced in the central nervous system when it is deprived of an adequate supply of oxygen even for a short time. The brain cells are more sensitive to oxygen want than the other cells of the body. One minute of complete lack of oxygen can cause severe brain damage or death. Asphyxia at birth is definitely related to serious degenerative changes in the brain as the child grows older. Excessive sedation of the mother may be the causative factor. Severe asphyxia causes cerebral congestion and sometimes spasm of the arterioles. Thin walled vessels burst causing hemorrhages which may be subdural, subarachnoid, or intraventricular. These hemorrhages can produce further anoxia.

Dr. DeLee of Chicago, in a discussion of obstetric analgesia, stated that, during the time he did his own postmortem examinations of babies, he noted the great frequency of minute hemorrhages in the adrenal glands, at the base of the brain, and in the basal ganglions. This discovery led him to the conclusion that some endocrinopathies are due to injuries suffered at birth. This opened a new field of speculation about possible causes of such conditions as epilepsy, psychopathic personality, and lesser degrees of mental inferiority. Asphyxia that occurs without the extensive use of sedatives and anesthesia during labor and delivery may be due to prematurity of the infant, the age, parity, and health of the mother, accidents of labor, use of oxytocins, and operative delivery. Asphyxia may occur in versions with extractions, mid forceps delivery, high forceps delivery, and rotations. In cesarean sec-

tions, the element of trauma is avoided, but that of sedation and anesthesia often is not. In cesarean sections, the sudden change from intrauterine pressure to atmospheric pressure may cause cerebral hemorrhage. Many obstetricians give their patients vitamin K within two hours of delivery. The baby is also given vitamin K if the delivery has been difficult.

Anesthetic Technics

The obstetric patient is usually easy to anesthetize. She has had sedation, she wants the relief that anesthesia affords, and she is tired and offers very little tissue resistance. When delivery is spontaneous, an analgesic should be given as soon as crowning occurs. The patient can hear conversations and respond to directions but cannot feel pain. When actual delivery is imminent and the obstetrician asks for anesthesia, the percentage of anesthetic gases should be increased. If necessary, a small amount of ether may be added. When the head is delivered, the inhalation bag should be emptied and filled with oxygen. Helium may be included in the anesthetic mixture as a safety measure to prevent explosions and also the production of atelectasis. If repair work is to be done, anesthetic gases should be added to the oxygen mixture as soon as the cord is clamped. As little ether as possible should be used because ether has a tendency to produce a relaxed uterus and freer postpartum bleeding.

For low forceps delivery the patient is anesthetized until she does not react to pain. If the delivery promises to be short, the bag is emptied gradually so that it will be almost completely empty when the forceps are removed. A high percentage of oxygen is used with a low percentage of anesthetic gases. As soon as the head is born, the anesthetic gases are turned off, and the bag is completely emptied. Then the bag is filled with oxygen, and 100 cc. helium is flowing. Usually by the time the cord has stopped pulsating, the baby is pink and crying. The baby often cries as soon as it is born. If the baby is premature, the mother is given oxygen and helium to breathe until the obstetrician is ready. Analgesia is given during the greater part of the delivery. If outlet forceps are used, a high percentage of oxygen is administered with the anesthetic gases while the forceps are being applied. As soon as the forceps are in place, the flow of anesthetic gases is reduced to an analgesic percentage. As soon as the premature infant is born, it is placed in a warm blanket and given oxygen until it cries vigorously. Plenty of oxygen and maintenance of normal body heat are most important in saving premature infants.

Surgical anesthesia is necessary for high forceps delivery, mid forceps delivery, and versions with extractions. The obstetrician must have a completely relaxed patient. During repair work, the anesthesia should be kept light enough so that the patient's eyes are active.

Patients for cesarean section are given atropine, gr. 1/150, and sometimes demerol, 50 mg. Usually no other premedication is given. If heavy sedation has been given, 150 mg. nicotinamide intravenously is indicated. Ethylene and ether are administered until the uterus is incised; then ether is discontinued if a low cervical cesarean section is being performed. While the forceps are being applied, the bag is emptied and filled with oxygen and helium. The

mother breathes this mixture until the cord is clamped. Cyclopropane is then given until the operation is completed. The patient should be awake before leaving the operating room. If a classic cesarean section is being done and the surgeon is a fast operator, cyclopropane is given. As soon as the surgeon grasps the baby's feet, the bag is emptied and filled with oxygen and helium. The mother breathes this mixture until the baby's cord is clamped. Then the anesthesia is continued with cyclopropane. When the surgeon is slow, the use of cyclopropane is not satisfactory; frequently the baby is slow to breathe and shows signs of cyclopropane poisoning. The symptoms may last for several hours. The use of ethylene is preferable when the cesarean section is prolonged. The baby should be born within 10-15 minutes after the mask is placed on the mother's face. Practically all maternity patients are given sedation before delivery. If, in addition, the baby has been subjected to long deep anesthesia, it may be born asphyxiated or sleepy.

For breech delivery, the patient is given analgesia as soon as the breech can be seen. She is encouraged to work with contractions until the obstetrician is ready to deliver the first leg. At this time, the anesthesia is deepened. For easy delivery of the after-coming head, the obstetrician needs deep surgical anesthesia.

Bandl's Rings

Patients who have persistent Bandl's rings may need a Porro's operation. Many times Bandl's rings can be relaxed with cyclopropane, cyclopropane and ether, or nitrous oxide, ether, and adrenalin. The anesthesia for relaxation of Bandl's ring needs to be very deep. Occasionally, the anesthesia needs to be carried so deep that passive respiration is necessary. After a few moments of anesthesia at that depth, the uterus will begin to relax. As soon as the uterus is relaxed, the obstetrician makes a very rapid delivery. When the head is almost born, the bag is emptied and filled with oxygen and a little carbon dioxide. Usually, the mother awakens quickly, and the baby cries soon after birth.

Helium

When helium is added to the anesthetic mixture, a patient with an upper respiratory tract infection or a pneumothorax for tuberculosis breathes more freely and quietly and has fewer complications. As a rule, a patient with heart disease can lie flat on the table after a few inhalations of the mixture. If she is apprehensive, she should be allowed to have one or two pillows. The pillows are removed after the patient is assured that she can breathe without difficulty.

Summary

The importance of anesthetics' being given by a competent, well trained anesthetist has been stressed. The necessity of having modern anesthetic equipment in the delivery room has also been shown. The obstetric patient is now given the same consideration in modern hospitals that is given the surgical patient. The many serious complications that are the result of poorly conducted anesthesia have been noted. The technics described have been used by the author and have been found satisfactory.

MENTAL AND EMOTIONAL PROBLEMS OF ANESTHESIA

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The anesthetist occupies a strategic position as a pilot through a critical event. A safe passage depends on the anesthetist's mechanical skill acquired during preliminary training and through practical experience. This is the science of anesthesia which can be mastered with a high degree of efficiency. Proficiency comes from a broader view, an understanding of the mental and emotional status of the patient. This is the art of anesthesia.

To define emotion is difficult, yet everyone understands in a general way the meaning of love, hate, fear, and anger. Furthermore, it is well known that the emotions affect body function, and in recent years great advance has been made in the analysis of these relations. The most important emotion related to anesthesia is fear.

Simple acute fear may be a useful emotion; e.g., because of fear of being burned, one does not touch a hot stove; because of fear of shock, one does not touch a live wire; because of fear of being hit, one gets out of the way of a falling object. More intense fear becomes fright, e.g., the experience of having been burned by a hot stove may make a person afraid of all stoves. This reaction is partly useful and partly harmful. Prolonged fear becomes anxiety and is harmful. The difference between fear and anxiety may be illustrated by comparing reactions to warnings about cancer. When the desirability of periodic examination for the early detection of cancer is mentioned to one type of person, simple and useful fear prompts him to be examined, and when he is told he has no cancer, he forgets about it. Another type of person worries about every pain and avoids examination lest he be told that he has cancer. His continued anxiety about cancer causes more and more pain and is harmful. The intensity and duration of fear, therefore, determines whether it is useful or harmful. It is harmful fear, or anxiety, as it is related to undergoing anesthesia with which we are now concerned.

Read before the Tri-State Assembly of Nurse Anesthetists, Chicago, May 5, 1947.

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Fear of Death

Fear of death is common. It is often difficult to determine whether a patient's fear of death refers to the operation or to the anesthesia since they are closely related. At least half of the patients going to the operating room entertain the idea that they will never return alive. This is only natural, for self preservation is the most fundamental of the instincts. If an opportunity arises for this fear to be discussed with the patient, he may be assured that he has better than 99 chances out of 100 of returning safely to his room, or he may be told that the risk is less than

that of riding in an automobile or of carrying on ordinary activities in the home. In this connection it seems important not to let a patient die in the operating room. In an extreme emergency, when there is little chance that any operation will save a patient, every effort should be made to get the patient back to his room if possible. In the mind of the lay person, the horror of death during an operation is much greater than that of death occurring in bed.

That fear of operation and anesthesia may have serious effects cannot be denied. I recall a patient, observed during my intern year, who died of fright. She was to be operated on for removal of a toxic goiter. She was brought to the operating room and placed on the table. Just before the anesthetic was started, the patient died. In retrospect it seems probable that if she had been properly prepared the tragedy would not have occurred. It was a lesson long to be remembered.

Fear of Choking

Fear of choking on the anesthetic is fairly common. There was good reason for this fear in the days when a large amount of ether was poured into a cone which was then held tightly over the patient's face until he stopped struggling. The memory of such an experience is long retained and reported with many embellishments to interested listeners. It takes a long time for such rumors to be quelled, and we still hear an occasional vague reference to those early experiences. "Crowding" an anesthetic may produce a similar effect, and, as you know, the interpretations of "crowding" vary greatly. Ample methods to prevent choking have now been developed, and a patient may be assured that there is no real danger. The best answer to a patient afraid of choking is that such an accident no longer occurs.

Fear of choking may include fear of swallowing the tongue. Many persons believe that swallowing the tongue during anesthesia is a common experience. Since obstruction to the air passages occurs at a level of anesthesia when consciousness is lost, a patient's knowledge of such a complication can be based only on reports and not on his own experience. Witnesses of anesthesia and postanesthetic recovery should be warned of the danger arising from a casual remark that might be misinterpreted as referring to swallowing the tongue.

Fear of Restraint

Fear of restraint is engendered by reports of patients who were strapped to the table before the anesthetic was begun. At one time restraining patients was the usual practice. Unfortunately and unnecessarily this procedure is still sometimes used. That patients who are restrained struggle far more than those who are free is well known. A patient can now be assured that he will not be unduly restrained.

Fear of Pain

Fear of pain may be manifested in a patient's request to "Be sure I am asleep before the operation starts; I cannot bear to think of feeling the knife." To the anesthetist this may seem absurd, but let me relate one experience to show how real the problem may seem. Almost every patient coming from one ward expressed this fear. Investigation revealed that a hysterical

girl recovering from an operation told everyone near her about her operation. She maintained that she remembered everything and related every detail of her trip to the operating room including, with a high degree of accuracy, all the steps of the operation, the instruments, and so forth. Her vivid imagination and a superficial knowledge of operating technic made it possible for her to present a plausible story. She repeated the story so often that she apparently came to believe it and more or less convinced her listeners. It may be necessary, therefore, to assure some patients that they will feel nothing while under general anesthesia.

Fear of Telling Secrets

There is some justification for a patient's fear of telling secrets, for partial anesthesia, amytal narcosis, and similar procedures have been used by psychiatrists to bring out experiences relegated to the patient's subconscious. Lay magazines have done much to popularize this idea. What has not been sufficiently emphasized is that suggestion is necessary to elicit the response. All anesthetists should be familiar with response to suggestions. Whether it is used with benefit or is permitted to become harmful may or may not be under control of the anesthetist. The possible beneficial and harmful effects are illustrated in the following incident.

A surgeon preferred "'primary ether" whenever possible. This method consisted of inducing relatively deep anesthesia at the time the operation was begun. The patient was then allowed to come out of the anesthesia to a primary level. She would respond to questions when asked. Positive suggestions were made to assure her that she was doing well. An operation for goiter was proceeding satisfactorily until the surgeon asked, "Does it hurt you?" After a lapse of a few minutes the patient reiterated, "It hurts me." It was then necessary to deepen the anesthesia to block out the effects of suggestion, after which she was allowed to come out of the anesthesia to a primary level. The anesthesia proceeded smoothly as long as only helpful suggestions were made. Many similar experiences could be cited. Your own experiences during induction of anesthesia would afford equally good illustrations of the effect of suggestion.

Some of the remarks a patient makes before anesthesia is begun and during the first part of induction are recalled vividly and accurately at a later time. During the induction the senses are dulled. When the eyes are covered, sight is lost. After a few inhalations of the anesthetic, taste and smell are no longer appreciated. Hearing is retained longer, and the perception of sound may be exaggerated. The last of the senses to be lost is feeling. Since mental images depend upon correlation of stimuli from the special senses, a disturbance in the balance of stimuli may give rise to vague or abnormal impressions. Hence, a quiet room, guarded conversation, elimination of noise, and as little restraint as possible are desirable. During the recovery from anesthesia the process is reversed; vagueness gradually gives way to clarity. By using the same caution to avoid unfavorable stimuli at this time, confusion and an unpleasant memory of abnormal mental impressions may be prevented. A recent incident will illustrate:

A patient was seen during her recovery from the anesthesia after a long operation. I remarked to her that she

had been a good soldier. Later I learned from her family that she thought I had said she was a good soul. In her confusion she thought, "Soul—soul—I must be dead for they are talking to me about my soul." The residents who were with me at the time of the visit recalled that the word "soldier" had been said distinctly. The patient, however, was not in a state to respond normally to stimuli.

A patient's fear of what he may say under anesthesia is broader than a fear of merely giving away secrets. The larger fear is explained by the patient's vague memories of the transitional stages of going into and recovering from the state of anesthesia. Those who have not had an anesthetic may have heard reports from others who have had the experience. What can be done to allay this fear? Conversation and noises can be controlled. By her behavior, the anesthetist can gain the patient's confidence before the anesthetic is administered. The patient can be assured that he is not likely to tell his secrets and that, even if he does, they will never be repeated. If the operation is to be performed with the patient under spinal anesthesia, the anesthetist has added responsibilities, for it is difficult to eliminate noise and conversation during the operation. Preliminary sedation may keep the patient in a prolonged state of vagueness. Helpful suggestions may counteract the influence of unfavorable surroundings.

Fear of Loss of Consciousness

Fear of loss of consciousness is natural and to some degree is probably experienced by everyone. This fear is related to the most fundamental of the instincts, self preservation. Possession of all the senses gives one a feeling of security. Natural loss of consciousness as in sleep is accepted because one is accustomed or conditioned to it. Furthermore, the senses are not entirely obliterated during sleep, for one awakens immediately in response to various stimuli. During anesthesia, however, loss of consciousness is complete. To place one's life in the hands of another requires courage and great confidence.

Fear of the Unknown

Fear of the unknown is common throughout life and includes a variety of feelings, e.g., concern about the outcome of a business venture or an examination, a sense of insecurity, and so forth. Most of the common fears related to anesthesia have been mentioned, but now and then an individual fear, usually related to some personal experience, will be noted. Discussion of the common fears with the patient gives him an opportunity to mention any other causes for worry. These can be handled individually, according to their merits.

Among the emotional states that might be classed as fear is concern about personal appearance. It is no small matter to a fastidious woman to be deprived of her cosmetics and finery. The usual hospital gown is not flattering, and removal of a denture is often a cause for embarrassment. The individual response to these problems is so variable that generalization is not possible, but any comfort the anesthetist may give will be appreciated.

Emotional Problems in Obstetrics

In obstetrics, emotional problems are plentiful, but fear of anesthesia is not prominent. All of the fears already mentioned may occasionally be encountered, but only fear of pain is greater in rela-

tion to labor than in relation to an operation. Anything to relieve pain is welcomed. The obstetrician and the obstetric nurse thoughtfully consider the relief of pain during labor. The amount of sedation given before delivery influences the need for anesthesia and the patient's reaction to the anesthetic. The anesthetist should be informed about the emotional status of the patient and the previous reaction to sedation. If the anesthetist is not given this information, the difficulties of anesthesia are increased.

The obstetric patient seldom has a fear of choking. On the other hand, choking presents a real problem for the anesthetist. Interrupted light anesthesia is conducive to vomiting, and when a patient has eaten recently, choking may be serious and occasionally fatal.

Fear of restraint is expressed more by action than by words. Explaining to the patient the purpose of necessary restraint will help to allay this fear.

Interrupted anesthesia in obstetrics multiplies the chance of an unfavorable response to suggestion. The patient passes through the transition zone of going into and recovering from the state of anesthesia many times. Furthermore, while waiting for contractions to recur, it is difficult for the doctor, nurses, and anesthetist to refrain from conversation. During this interval the patient is in a more or less confused state, and remarks entirely unrelated to her may be assumed to be personal. Too much emphasis cannot be placed on the importance of allowing only helpful suggestions to be made.

With the introduction of continuous caudal and spinal anesthesia, the patient has been given an opportunity to express a preference. However, choice of the type of anesthesia should not be left to the patient, for too often the apprehensive individual is most insistent that one of the newer methods be used. It may be fear of loss of consciousness that prompts the choice. This attitude is easily appreciated and deserves careful consideration.

Summary

In reviewing the emotional status of a patient in relation to an operation, it is readily seen that the cause for fear of pain has been practically eliminated by the discovery of anesthesia. Other fears that have been introduced can be controlled by sympathetic consideration. The first step in giving relief is recognizing the problem. The mechanics of anesthesia have been reasonably well standardized, but competent management of the patient's emotional problems depends largely upon the personality of the anesthetist. A mastery of the mechanics is essential to the anesthetist if she is to have confidence in herself. It is assumed that the qualified anesthetist is a good mechanic, but the true artist combines this mechanical skill with a sympathy, understanding, and a knowledge of human reactions.

QUALIFYING EXAMINATION

The seventh qualifying examination for membership in the American Association of Nurse Anesthetists will be held on Apr. 26, 1948. Applications for this examination should be filed by Mar. 1.

THE NURSE ANESTHETIST AND HER CO-WORKERS IN THE HOSPITAL

Sister Henrietta Guyot*
New Orleans

In considering the history of general anesthesia, we go back scarcely more than 100 years. In 1842 Dr. Crawford Long of Georgia removed a small tumor from the neck of a patient under ether. However, Dr. Long published no accounts of his work until later, and the discovery of ether for surgical anesthesia is most often attributed to Dr. William Thomas Green Morton, who in 1846 arranged for the first hospital operation under ether at Massachusetts General Hospital. The tremendous influence that the discovery of ether as a general anesthetic had on the field of surgery is well known.[1]

Dr. E. A. Rovenstine describes four stages in the development of anesthesia. The first of these he calls the *period of discovery,* which included the introduction of ether, chloroform, and nitrous oxide. Vast opportunities in the realm of surgery were opened with the use of these gases. Anesthesia, however, was not looked upon as a science in itself, but merely as a means to an end, namely, to permit the surgeon to operate with greater ease. In *the prescientific stage,* which followed the period of discovery, new drugs and new appliances appeared. Commercial houses began to offer training courses in the technic of administration of anesthetics, and some medical schools included a few lectures on anesthesia. Technical instruction predominated, however. The 20 year period following World War I can be looked upon as a *"renaissance period"* when anesthesia was coming into its own. Research activities and recognition of the influence of anesthetics on postoperative morbidity and mortality stimulated interest in, and a greater appreciation for, the science of anesthesia. Rapid strides were made in orthopedic, thoracic, brain, and plastic surgery, and more extensive abdominal operations were performed. In the present period, called *the scientific era,* there are available many agents and methods for producing anesthesia, including inhalation, intratracheal, spinal, intravenous, intramuscular, and local. More doctors have entered the field of anesthesiology, and standards for admission to the American Board of Anesthesiology have been set up. Thus, in scarcely a century, the practice of surgery has been revolutionized, and a new science has sprung up, has been nurtured, and has grown to full stature.[2]

The nurse anesthetist has made a major contribution to the development of the young science of anesthesia, chiefly through the practical administration of

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Read before the Institute for Nurse Anesthetists, New Orleans, May 26, 1947.

*Director, School of Nursing and Nursing Service, Charity Hospital.

1. MacEachern, M. T.: **Hospital Organization and Management,** ed. 2 (Chicago: Physicians Record Co., 1946) p. 17.

2. Sanders, R. L.: Surgeon-anesthetist relations. Anesthesiology **6**:273 - 278, May, 1945.

new types of anesthetics which appeared throughout the years.[3,4] The first name to appear on the record of outstanding nurses in the field is that of Miss Alice Magaw, a graduate of Women's Hospital School of Nursing in Chicago. She was appointed as anesthetist to Drs. Charles and William Mayo in 1892 and wrote the first article on anesthesia by a nurse anesthetist. This article, "A Review of Over 14,000 Surgical Anesthesias," published in *Surgery, Gynecology, and Obstetrics* in 1906, described the open drop method of administering ether in this remarkable series of cases without a death directly attributed to the anesthetic.

Discoveries and inventions created a need for trained anesthetists, and the first known school of anesthesia for nurses was begun in 1911 at Lakeside Hospital, now the University Hospitals, at Cleveland, Ohio. Miss Agatha Hodgins was placed in charge, under Dr. George W. Crile, professor of surgery, Western Reserve University, and chief surgeon at Lakeside Hospital. World War I gave many nurse anesthetists an opportunity to serve overseas, but they did not restrict their activities to service only, for they contributed much abroad by teaching the use of nitrous oxide. The two decades following World War I saw the establishment of schools of anesthesiology for nurses in many different sections of the country, and today there are 54 such schools in the United States.

Following the usual history of professional groups, the increasing numbers of nurse anesthetists in due time called for organization, and again Agatha Hodgins took leadership, in 1931, in founding and serving as first president of the National Association of Nurse Anesthetists. The objectives of the association dealt with the standards of education for the nurse anesthetist and with opportunities for the nurse to increase her knowledge and technical skill through meetings and conferences and through the publication of a journal devoted to subjects of interest and value to the nurse anesthetist. That the organizaion is fulfilling these objectives is evidenced by the active program of the American Association of Nurse Anesthetists, which is the present name of the organization. The excellent quarterly journal, the forward-looking national examination program, the curriculum with its revisions keeping it up to date, and the plans for national approval of schools, all tell eloquently the story of progress being made by this young organization.

Who Should Supervise the Anesthesia Service in the Hospital?

Considering the present situation in the field of anesthesia, with its large number of nurse anesthetists and an ever increasing number of doctors entering the field, there may be real reason for confusion over the question of responsibility for the anesthesia service in the hospital. The American Hospital Association[5] advocates the organization of the anesthesia service as a department under the direction of a qualified person who should be responsible for all the anesthesia in the hospital. Furthermore, it believes that every hospital anesthesia department should be under competent medical

3. Anesthesia: A career for the graduate nurse. Bull. Am. Assn. Nurse Anesthetists **10**:97-104, May, 1942.

4. Fife, Gertrude: The nurse as an anesthetist. Am. J. Nursing **47**:308-309, May, 1947.

5. **Principles of Relationship Between Hospitals and Radiologists, Anesthetists, Pathologists** (Chicago: American Hospital Association, 1946).

direction, preferably under a qualified specialist in anesthesia. If, because of size or isolation of the hospital, or for other reasons, such an individual is not available, some member of the general medical staff, paying particular attention to anesthesia, should be in charge.

Dr. Frank R. Bradley,[6] director of Barnes Hospital, St. Louis, in a paper read at the annual convention of your association, Oct. 2, 1946, considers the situation in hospitals affiliated with medical schools. He visualizes the medical anesthetist as a liaison between physiology, pharmacology, and applied anesthesia. He would have him participate in the theoretical instruction of the nurse anesthetist, but leave to the chief or administrative nurse anesthetist the routine training of the student nurse anesthetists, while he assumes responsibility for training interns, residents, and medical students.

LEGAL ASPECTS OF POSITION OF NURSE ANESTHETIST

A recent article in the *Journal of the American Association of Nurse Anesthetists* by an attorney in New York City has summed up the legal aspects of the administration of anesthetics by nurses.[7] In answer to the objection to the administration of anesthetics by a nurse on the grounds that in so doing she practices medicine, Mr. Hayt, the author, states that the practice of medicine consists of three things: first, in judging the nature, character, and symptoms of the disease; second, in determining the proper remedy for the disease; third, in giving or prescribing a remedy for the disease. He goes on to explain, however, that the mere giving of medicine prescribed by the physician has never been considered the practice of medicine. Furthermore, a nurse administering a prescribed anesthetic in the presence of, and in accordance with the directions of, the surgeon in charge does not practice medicine within the meaning of that term.

The right of nurse anesthetists to administer general anesthetics was upheld by the supreme court of California in the Chalmers-Francis v. Nelson case about 10 years ago.[8] The court held that "nurses in the surgery during the preparation for and progress of an operation are not diagnosing or prescribing within the meaning of the medical practice act." The court further held that the evidence clearly showed that the nurse anesthetist merely carries out the orders of the physician to whose authority she is subject.

Mr. Hayt declares that, whereas many states now regard anesthesia as the practice of medicine, the tendency is toward the liberal interpretation of the law which allows a nurse or technician to act as an agent of a qualified practitioner. The most important point to remember, however, is that the surgeon assumes responsibility for the nurse's actions.

When a nurse anesthetist is employed by the hospital, the surgeon has the right to assume that she is competent, and he is not chargeable with her incompetency unless it is shown that he is aware of her lack of experience and skill.[9] He is obliged, how-

6. Bradley, F. R.: The challenge to the nurse anesthetist. J. Am. Assn. Nurse Anesthetists **15**:19-21, Feb., 1947.

7. Hayt, Emanuel: Anesthesia: legal and illegal. J. Am. Assn. Nurse Anesthetists **15**:26-34, Feb., 1947.

8. Right of nurse anesthetist to administer general anesthetic upheld by Supreme Court of California. Bull. National Assn. Nurse Anesthetists **4**:146-147, Aug., 1936.

9. Knight, R. T.: The ethics of anesthesia and the nurse anesthetist. Hosp. Management **56**:62-63, July, 1943.

ever, to give her proper instructions.

The Nurse Anesthetist as Co-Worker of the Surgeon[10,11]

In literature, the surgeon and the anesthetist are constantly referred to as a team. Working in the closest co-operation, they achieve together the wondrous feat of bringing a patient to death's door and back again. It is an intimate type of co-operation, involving the greatest possible mutual dependence. In assuming responsibility for the patient, the surgeon accepts, as has been said, legal responsibility for the work of the anesthetist. A realization of the responsibility the physician incurs for her actions should foster in the anesthetist a continuous awareness of her obligation to administer anesthetics as safely and as intelligently as possible.

What does the surgeon expect of the anesthetist? His first requirements are keenness of mind and alert intelligence. In the words of a professor of surgery "no surgeon should ever do anything according to routine, because if he does he stops thinking"; the same is true for the nurse anesthetist. The administration of a drug which by its very nature is lethal does demand a resourcefulness that is not in harmony with routinized thought. The serious procedure which the surgeon and nurse anesthetist are performing requires absolute attention to what they are doing and forbids indifference or distraction. Should this constant attention and application to what they are doing produce tension, an intelligent understanding of the psychology of human nature will help to prevent antagonism and hard feelings.

In addition to intelligent alertness, the surgeon expects his nurse anesthetist to know the whys and wherefores of what she is doing. These depend upon her knowledge of the basic principles of certain sciences, namely, pharmacology, physiology, anatomy, psychology, and surgery. It might conceivably be possible to train a skilled technician of anesthesia without imparting a knowledge of scientific principles. Such a method would be mere training, however, and it could never be termed real education in the science of anesthesia. Moreover, the safety of the patient would be jeopardized to an inexcusable degree. We are not permitted to be ignorant of those things which our professional work demands of us.

Furthermore, the surgeon has the right to expect that a nurse will be able intelligently to interpret a patient's laboratory findings and report of physical examination, and be aware of the degree of risk involved in each operation. Not only does he expect her to be informed about the patient's condition, but he depends on her ability to cope with emergencies. Ignorance on her part throws an added burden on him when he may have major problems confronting him in the control of hemorrhage or other serious complications during the course of an operation.

However, teamwork is not solely the responsibility of the nurse anesthetist; she likewise has certain rights. What may the anesthetist expect of the surgeon? Is it too much to say that she has the right to expect him to have a

10. Foss, H. L.: The surgeon and his anethetist. Bull. National Assn. Nurse Anesthetists **5**:350-352, Aug., 1937.

11. Flynn, C. W.: Relation of the anesthetist to the hospital and to the surgeon. Bull. National Assn. Nurse Anesthetists **6**:215-219, Nov., 1938.

fund of basic knowledge concerning anesthesia? The truism "a surgeon is nothing if ignorant of anesthesia" is of vital significance to her. It is his responsibility to select the anesthetic agent. Experience in co-operating with a certain anesthetist frequently gives the surgeon confidence in her opinion and suggestions, and the type of anesthesia is often selected in consultation with her. This practice can well test the anesthetist's real knowledge of scientific principles. Is her recommendation based only upon successful experience in administering a certain type of anesthetic for the particular operation to be performed, or can she base her recommendation on true scientific knowledge?

The anesthetist has the right to expect that the surgeon will have enough confidence in her ability to heed her signals or warnings. The average surgeon calmly proceeds with the operation and trusts the judgment of his anesthetist.

Patience and consideration of the feelings of others, together with an understanding of the difficulties involved in the administration of an anesthetic, are desirable qualities for the surgeon. Should he go further and occasionally offer a word of encouragement, he will undoubtedly have not only the respect but also whole-hearted co-operation of the nurse anesthetist. A sincere interest in the work of the anesthetist is manifested by helpful and constructive advice and criticism. I should like to emphasize the point that such advice and criticism is a sign of interest and not of antagonism. A nurse anesthetist who is a true professional worker will welcome such assistance from the surgeon.

The Nurse Anesthetist as a Hospital Employee

As a hospital employee, the nurse anesthetist generally finds herself in a minority group. Members of a minority group at times find that they have been excluded from general personnel policies and may not discover their lack of privileges until such time as they become ill or request a vacation. While it is not my intention to discuss the salary or privileges of nurse anesthetists, I believe that every anesthetist applying for a position is entitled to certain information.

The duties of the position for which she is applying will be one of the most important considerations to the nurse anesthetist. Irritation resulting from assignment of other hospital work when the anesthesia service does not require the full time of the anesthetist is usually the result of her ignorance at the time of employment that such work would be given to her. If, on the other hand, the nurse anesthetist accepts the position knowing that it will involve other work, she can hardly complain when this state of affairs exists.

The practice of giving raises in salary at regular intervals is not carried out in all institutions. However, any nurse anesthetist applying for a position has the privilege of asking if the hospital has a salary scale which provides for regular increases, after satisfactory service, of course. Inquiry about vacations, sick leave, and opportunities for promotion might also be made before a position is accepted. The working hours for the nurse anesthetist are often difficult to adjust, especially in smaller institutions where anesthetists must be on call. The unpleasant aspects of the

nurse anesthetist's position, involving at it does calls to surgery and to the obstetric division during the evening hours and during the night, may account in part for the willingness with which administrators pay higher salaries to anesthetists than to other nurses working on the staff.

On the other hand, the hospital has the privilege of stating definite requirements for nurse anesthetists as well as for other members of the staff. This is particularly important in relation to the hospital's liability for the actions of its employees.

In a well organized hospital there is no confusion about the position of each member of the personnel. A hospital organization chart should show where each group of workers finds its place in the institution and should answer the following questions for each individual:

1. Where do I fit into this picture?
2. To whom do I answer?
3. Through what channels do I go for clearance of any difficulties that may arise?

Working relationships between nurse anesthetists and other operating room personnel are often tense and irritating when they should be harmonious and promote efficient co-operation. At conferences between the operating room and the anesthesia service supervisory staffs, it should be clearly decided who is responsible for placing the patient on the table and in position, for removing the patient to the stretcher, for returning the patient to his room, and for reporting his condition to the nurse on hall duty. To allow friction to exist for a long time without making an effort to remove the sources of irritation is usually unnecessary and often results from a lack of objectivity. When we can be objective enough about situations to sit down in conference with coworkers who may have opinions differing from ours, look frankly at the facts of the case, and find a solution together, we have learned one of the most important technics in establishing good working relationships. On the contrary, if our approach is so subjective that "self" is injected into each and every discussion, and any proposed solution of a problem is judged merely in the light of its effect on us personally, we will probably leave the conference determined to retain our own opinon. When such an attitude is prevalent, you can readily perceive how a problem remains a problem.

The real secret of getting along with others lies in learning how to work in accordance with other persons' habits instead of at variance with them.[12] From this develop tolerance and patience. If we are interested in working co-operatively with others, we will observe how they respond to what we say and will eliminate, when we can, expressions and acts that do not bring forth cheerful co-operation. A real interest in others and a sincere desire to work harmoniously with them will soon be apparent to everyone with whom we come in contact. Selfishness usually accounts for a failure to show this interest in and consideration of others and likewise accounts for much of the difficulties that some persons have in dealing with others.

One final piece of information which the nurse anesthetist needs to know when she accepts a position is the hospital's policy with regard to the proce-

12. Sargeant, Florence: Psychology in anesthesia. Bull. National Assn. Nurse Anesthetists 5:254-255, Feb., 1937.

dures which she may perform. I refer here to the ever recurring question of whether nurse anesthetists may or may not insert intratracheal catheters, give intravenous medication and anesthetics, do spinal punctures, and so forth.

The Nurse Anesthetist and the Patient

Ten years ago an interesting article appeared in the *Bulletin of the National Association of Nurse Anesthetists* called "The Human Equation in Anesthesia."[13] In this article, Irene Mason made a number of excellent suggestions regarding the handling of patients who are scheduled for surgery. The nurse anesthetist, according to Miss Mason, should be interested in human nature. She should be able to sympathize with those who are weak and nervous, to be business-like with those who demand efficiency, and to be diverting with children who are terrified. In addition, anesthetists should increase their contacts with patients before operation and explain to them something of the nature of present day anesthesia. Phobias of one kind or another are not uncommon among patients, and a preoperative visit often gives the anesthetist an opportunity to reassure the patient and banish erroneous ideas. The patient's co-operation will usually be obtained. A knowledge of individual differences in patients based on a knowledge of individual differences in persons will often serve as a foundation for a good understanding of patients' reactions.

Along with technical training in the actual administration of anesthetics, nurse anesthetists need to learn the art of "vocal" anesthesia. The ability to speak to the patient in a low, well modulated, calm voice is only one aspect of this unique type of so-called anesthesia. Its complement is the ability to know what to say to each individual patient. To win the confidence of the patient during the short interval before the induction of general anesthesia is to practice an art. A visit the day before paves the way and makes the nurse anesthetist a friend who greets the patient upon his arrival at the operating room. The ideal nurse is a woman of culture, and, in the words of Sr. John Edward[14] in her discussion of the ideal nurse anesthetist at your meeting in 1936, "culture is not a luxury to be enjoyed by only the few." The cultured nurse quickly and easily adjusts to all types of patients. She never finds it necessary to raise her voice. With regard to voice training, it is possible to relax the muscles of the mouth and throat by deep breathing, which forces the tension down to the diaphragm. When relaxed, the nurse anesthetist soon learns to attain ease, and her voice will become modulated and gentle. First and foremost, however, the patient must be assured that the nurse anesthetist is the one person in the operating room who sees no one but him and that he is her special care. An individual interest in each patient is necessary to establish this confidence in the patient, but it will become second nature to the nurse who remembers how to put herself in the place of the patient.

It is customary to provide for postoperative follow-up of patients undergoing anesthesia to determine results.[15]

13. Mason, Irene: The human equation in anesthesia. Bull. National Assn. Nurse Anesthetists **5**:298 - 301, May, 1937.

14. Sr. John Edward: The ideal nurse anesthetist. Bull. National Assn. Nurse Anesthetists **4**:203-207, Nov., 1936.

15. Myers, Esther C.: The anesthesia department and the anesthetist. Bull. National Assn. Nurse Anesthetists **7**:194-197, Aug., 1939.

A guide covering the essential points to be noted will usually result in a more intelligent observation of the patient. Such a guide can readily be set up on a form which provides a permanent record. Compilation of data from many of these records will in time be of value in establishing results of the use of various types of anesthetic agents in relation to different operations.

Summary

1. After going through rapid changes characterized by remarkable progress, the young science of anesthesiology has now entered upon a scientific era and is attracting many physicians.

2. Standardizing groups recommend that anesthesia service in the hospital be controlled by a qualified medical anesthetist or by a physician especially interested in the specialty.

3. Legal interpretation tends to discredit the administration of anesthetics as the practice of medicine and holds the surgeon liable for the actions of the anesthetist. When an anesthetist is employed by a hospital, the hospital, and sometimes also the surgeon and the anesthetist herself, can be held liable.

4. Teamwork between the surgeon and the anesthetist is essential and is the result of mutual confidence and intelligent understanding of the part each plays in the operative procedure.

5. Although a member of a minority group, the nurse anesthetist can request definite information on personnel policies, duties, procedures she will be allowed to perform, her place in the organization, and so forth, before accepting a position.

6. Good working relationships with others in the hospital call for definite decisions on differentiation of duties, for an objective approach to problem situations, and for a sincere interest in co-workers as human beings.

7. Ideally, relations with patients should begin prior to their arrival at the operating room. A cultured soft voice and a reassuring manner can do much to establish confidence in the patient.

8. Postoperative follow-up of a patient undergoing an anesthetic should also be carried out and the data recorded.

KIDNEYS IN ANESTHESIA

(Continued from page 212)

The transfusion kidney[76,77] and the plugging of the renal tubules with crystals after sulfonamide therapy[78,79,80] add their share of difficulties by complicating anesthesia and surgery.

The aim of the anesthetist is to prevent damage to the kidneys during the administration of the anesthetic and to send the patient from the operating room with kidneys able to carry on their functions without interruption.

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76. Peters, H. R.: Anuria following hemolytic reaction to blood transfusion; recovery following splanchnic block. Ann. Int. Med. **16**:547-556, 1942.

77. Peters, J. T.: Oliguria and anuria due to increased intrarenal pressure. Ann. Int. Med. **23**:221-236, 1945.

78. Bradford, H. A., and Shaffer, J. H.: Renal changes in a case of sulfadiazine anuria. J.A.M.A. **119**:316-318, 1942.

79. Keitzer, W., and Campbell, J.: Renal complications of sulfadiazine. J.A.M.A. **119**:701-703, 1942.

80. Winsor, T., and Burch, G. E.: Renal complications following sulfathiazole therapy. J.A.M.A. **118**:1346-1353, 1942.

MEASUREMENT IN EDUCATION

Sister Helen Marie Hughes, M.A.A.N.A.*
Detroit

Measurement plays an important part in the practice of anesthesia, whether it be measurement of dosages of anesthetic gases or the measurement and evaluation of the students trained in the schools of anesthesiology. Teachers, therefore, should have a clear understanding of such common terms used in education as measurement and evaluation; objective and essay tests; scoring and grading; percentile rating, normal curve, and average deviation.

Measurement and evaluation are not one and the same. Loretta Heidgerken[1] clarifies the difference: "Measurement signifies appraisal of results, either with or without direct worth to the student, whereas evaluation signifies appraisal in terms of results having some direct worth to the student. Evaluation includes measurement, but adds to it the concept of factors which are intangible and not subject to quantitative determination." Measurement, then, is quantitative determination according to a given standard or norm. Evaluation goes a step further than measurement and is the final analysis of the information gathered by measurement, observation, and personal knowledge of the individual.

Just as measurement and evaluation are not the same, scoring and grading are not the same. According to Ross,[2] "Scoring is an objective process of counting right or wrong responses, whereas, grading always means interpreting quality in terms of some criterion. Strictly speaking, then, it is more correct to speak of grading or rating essay examinations than it is to speak of scoring them."

Scoring, accordingly, presupposes that an objective type test has been given. However, as Guilford states,[3] "A raw score of so many points means very little to us." For raw scores to have meaning for the student and to be of value to the teacher, they must be translated into terms showing the relation of the score of one student to the scores received by all the other students taking the same test. Two methods of reporting raw scores are the percentile method and the grade equivalent.

The percentile method of reporting raw scores is explained by Louise McManus[4] as follows: "A percentile rating corresponding to a given score tells what percentage or proportion of the group have scores lower than a given score. A percentile rating indicates the rank a particular score would assume if the class had exactly 100 students.

Read before the Assembly of Schools of Anesthesiology, St. Louis, Sept. 21, 1947.

*Director of Department of Anesthesiology, Mercy College, Mount Carmel Mercy Hospital.

1. Heidgerken, Loretta: **Teaching in Schools of Nursing** (Philadelphia: J. B. Lippincott Co., 1946).

2. Ross, C. C.: **Measurement in Today's Schools** (New York: Prentice-Hall, Inc., 1946).

3. Guilford, J. P.: **Fundamental Statistics in Psychology and Education** (New York: McGraw-Hill Book Co., Inc., 1946).

4. McManus, R. Louise: **Study Guide on Evaluation** (New York: National League of Nursing Education, 1944).

Percentile ratings equivalent to each score in each class may be calculated by the following formula:

$$\text{percentile rating} = 100 - \frac{\text{rank of score} \times 100}{\text{number of scores}}$$

To illustrate: To find the percentile rating of a student whose score ranked 51st in a group of 340 students:

$$100 \text{ minus } \frac{51 \times 100}{340} = 85 \text{ percentile}$$

85% of the group had scores below the particular score, while 15% had scores equal to or above it."

A simple illustration may be given to show the value of translating raw scores into percentile ratings. Let us assume that a student's raw scores were 59 in physiology, 175 in pharmacology, and 121 in chemistry. From the raw scores alone, one has no way of knowing whether the student ranked low in all the tests, high in all the tests, or low in some and high in the rest. Now let us assume that the percentile ratings equivalent to these raw scores were 99 in physiology, 32 in pharmacology, and 48 in chemistry. It is immediately apparent that the student ranked high in physiology and low in pharmacology and chemistry in relation to the scores received by the other students in the same class.

If raw scores are to be translated into grades rather than into percentile ratings, the first step is to describe each letter grade. Determining a method of grading is actually a faculty problem and is of sufficient importance to be a written policy or regulation.

If the letter grade is considered an evaluation of a student's performance, each letter grade might be described as follows:

A. This grade should be given to the superior student who does original thinking and more work than is required of her.

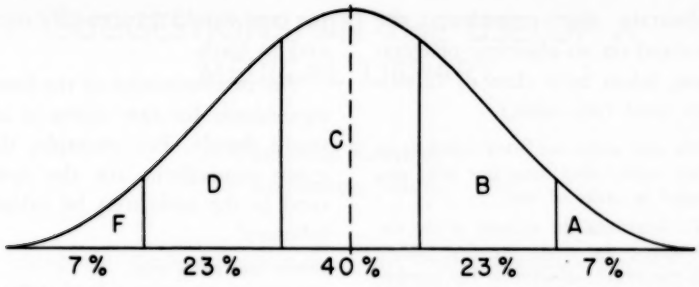
B. This grade should be given to the above average student who occasionally does original thinking and more work than is required of her.

C. This grade belongs to the average student, who rarely does original thinking and usually only the work that is required of her. An English professor once exclaimed indignantly, "God give you the grace to see the value of a C." Surely it is a worthy grade.

D. This belongs to the below average student. She does not do as much work as is required of her but, strangely enough, is not easily discouraged and seldom resigns from a course.

F. This grade is understood by all as failing.

The determination of the letter grade equivalents of raw scores is based on the principle that scores tend to cluster at the average and to scatter above and below. Theoretically, if a test is valid and reliable, and the class is a relatively large unselected group, the raw scores received will form a symmetrical curve when plotted on a graph (see figure). This is called the normal curve of probability. Because of this tendency for scores to cluster at the average and to be scattered above and below the average, the high point of the curve is in the center, from which the line of the curve slopes regularly in both directions. According to this concept, the percentage of high and low scores on a given test should be similar, the percentage of medium high and medium low scores should be similar, and the largest percentage of scores should be average. However, in a class of students with above average ability, the weight of the curve is thrown off center toward the high end. Likewise if the students are below average in ability, the weight



of the curve will be thrown off center toward the low end. It should be emphasized that the figure shows the normal curve of probability and the distribution of scores that one would theoretically expect to find in an average class.

In translating raw scores into letter grades, it is wise, as has been pointed out by Hawkes, Lindquist and Mann,[5] to determine the average of all the scores, and then to determine the amount of difference between each score and the average. The next step is to determine the average of all of the deviations of the individual scores from the average of the scores. This is called the average deviation. To use this method, all one needs to know is simple arithmetic. The rules and steps of this procedure are to be found in various texts on the construction and use of the objective examination. Hawkes, Lindquist and Mann[5] have presented this method clearly and concisely in *The Construction and Use of Achievement Examinations.*

5. Hawkes, H. E.; Lindquist, E. F., and Mann, C. R.: **The Construction and Use of Achievement Examinations** (Boston: Houghton Mifflin Co., 1936).

CALCULATION OF THE AVERAGE OF RAW SCORES AND THE AVERAGE DEVIATION

Raw Scores		*Deviation*
132		35
123		26
117		20
112		15
99		2
96		1
94	—97	3
93		4
90		7
88		9
74		23
50		47
Sum of scores 1168		Sum of deviation 192

Average of scores = sum of scores divided by number of scores, *or* 1168 ÷ 12 = 97.3*

Average deviation = sum of deviations divided by number in list, *or* 192 ÷ 12 = 16

*97.3 rounded out to nearest whole number is 97.

To illustrate this procedure, the scores received on an objective pharmacology test, taken by a class of 12 students, are used (see table).

Step 1.—The raw scores are listed in whatever order they come; they may, but need not, be arranged in order of size.

Step 2.—To determine the average of the ungrouped scores, the scores are first added, and then the sum is divided by the number of scores in the list. The quotient need not be carried out beyond the first decimal place and is rounded out to the nearest whole number. This quotient is the average of the raw scores.

Step 3.—Next the difference between the individual raw scores and the average is determined. To do this, one subtracts the average from the individual raw scores. The result is placed in the "deviation column" opposite the raw scores (see table). Although some of the results will be minus quantities, the minus sign is ignored. "We can disregard signs in this instance for the reason that we are not concerned about the direction of the deviations but only about their size."[3]

Step 4.—To determine the average of these deviations, the column of deviations is added and the sum divided by the number of items in the "deviation column." The result is the *average deviation*.

Having once determined the average of the raw scores and the average deviation, it is possible to determine the letter grade equivalents for the individual raw scores. The range of the raw scores is represented by the base line of the graph in the figure. It has been found statistically that if the area enclosed in the curve is divided by lines drawn from the five points on the base line, the percentage of the total area of each division is as follows: A 7 per cent, B 23 per cent, C 40 per cent, D 23 per cent, and F 7 per cent. Accordingly, 7 per cent of the persons taking the test would theoretically receive A's, 23 per cent would theoretically receive B's, and so forth.

The determination of the letter grade equivalents for raw scores is comparatively simple. For example, the letter grade equivalents for the raw scores used in the table may be calculated as follows:[5]

Lower limit of A area:

(2 × the average deviation) + the average

or

$(2 \times 16) + 97 = \mathbf{129}$

Lower limit of B area:

(⅔ × the average deviation) + the average

or

$(\frac{2}{3} \times 16) + 97 = \mathbf{107.6}$

Lower limit of C area:

the average —(⅔ × the average deviation)

or

$97 - (\frac{2}{3} \times 16) = \mathbf{86.4}$

Lower limit of D area:

the average —(2 × the average deviation)

or

$97 - (2 \times 16) = \mathbf{65}$

Accordingly, for the class of 12 students taking the objective pharmacology test, the grades would be distributed as follows:

A (129 and above) = 1 student
B (107 - 128 inclusive) = 3 students
C (87 - 106 inclusive) = 6 students
D (65 - 86 inclusive) = 1 student
F (64 and below) = 1 student

According to Guilford,[3] "The average deviation finds its greatest usefulness when we are dealing with a small number of distributions." However, a word of caution needs to be presented at this point.

Important as it is to have a method for determining how to assign grades, it must be remembered that such a method should not be used blindly. In some cases where the class is better than average, more than 7 per cent of

(Continued on page 256)

3. Loc. cit.

5. Loc. cit.
3. Loc. cit.

SUGGESTIONS ON THE USE OF A MEDICAL LIBRARY

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Those engaged in medical practice or research often find it necessary to peruse the literature in their field in order to have knowledge of contributions which may affect their work. The most efficient use of a medical library comes with practice and experience with the indexes to books and periodicals, for a person well versed in use of bibliographic guides and catalogues can locate current and historical references with relative ease.

It is advisable for an individual who is not acquainted with a library to introduce herself to the librarian, or assistant, in order that the librarian may give her an idea of the library's files, arrangement, privileges, and rules. Thereafter, when problems arise and assistance is needed, she should consult the librarian. Frequently, a brief discussion of the problem at hand will enable the librarian to suggest additional sources or short cuts for finding material on the subject, such as encyclopedias, handbooks, reviews, and selective bibliographies.

A person learns the authoritative reference works on a specific subject, often only after spending endless hours of searching. Knowledge in the use of the library's subject indexes for books and periodicals will make familiarity with the source literature in any field less arduous and more productive.

The Card Catalogue

The library's card catalogue is the index to the volumes contained in the library. Generally it is limited to the classified books in the collection. The classification of a book is the selection and assignment from the authoritative schedule in use in the library of the number which most clearly defines the subject matter contained in the book. Textbooks, monographs, treatises, handbooks, dictionaries, directories, and encyclopedias are generally classified.

A serial is a publication containing contributions by various authors published under the same general title at more or less regular intervals. Journals, annual reviews, reports, collected papers, and other such periodicals are examples. Serial publications may be classified and filed in the card catalogue, but usually periodical holdings are indexed simply by title in a separate file. The published indexes to medical journals index the contents of these publications by subject and author.

For each book in the library one can expect to find cards in the catalogue under the main entry (usually the author), joint authors, the subjects covered by the work, and the title of the book. Medical libraries often eliminate the title cards because many of them

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are identical to the subject covered, but if the title is distinctive a card will be in the file. For books with such titles as *Textbook of Pathology* or *Treatise on Gout,* title entries are not necessary since the book can be found under the subject entries "Gout" or "Pathology." However, it is obvious that title cards are needed for such striking titles as *Miracles from Microbes* and *Rats, Lice and History* because these books are more likely to be remembered by title than by the author or subject. In the library's card catalogue the author and title entries are printed or typed in black. On the subject entries the subject is typed in red on the top line, and the rest of the card is printed or typed in black. Entries concerning books by an author are filed ahead of those about the same individual. Thus, under the black author entry, "Osler, Sir William," will be filed in alphabetical order cards for the titles of his books contained in the library's collection. Following these are filed the subject entry cards bearing the words "Osler, Sir William" in red for books about Osler which the library has.

Authoritative lists of subject headings are kept and followed by libraries to maintain uniformity. Reference cards for accepted terms not used in the catalogue direct a person to the term used by the library. This card is called a "see reference card." Anyone in search of material on orthopedics may find a card which says: "Orthopedics, see, Surgery, Orthopedic." Certain cards called "see also cards" are filed at the end of the cards on certain subjects to refer anyone interested to related subjects under which additional information can be obtained. Thus under the subject entry "Anesthetics" are included cards for all the books in the library on this subject. Following these cards is a card which refers to related subjects. This card may read: "Anesthetics, see also, Chloroform; Ether; Anesthetics, Local; Anesthetics, Spinal."

The main entry, or author card, is the card containing the most complete information about the book. It is a description of the book. Beginning with the title page it cites the authors, title, edition, place of publication, publisher, and date in this order. The date following the publisher's name is the date on which the book was published. In addition, the dates of the author's birth (and death, if he is deceased) immediately follow his name on the first line of the card. Also given are the number of pages in the book, number of illustrations, series or volumes, and, frequently, a résumé of the contents and explanatory notes. To save space in catalogues the subject and added entry cards often refer the reader to the main entry card for complete information or contents, notes, and so forth, since frequently the main entry, on which the book is fully described, will consist of two or more cards.

The "call number" appears in the upper left margin and is the key to the location of the volume in the stacks. It is the combination of the classification number and the symbol for the author's name, and sometimes includes also the edition and year of publication as well as the copy number. In libraries in which the stacks are not open to the reader, this number must be given to the attendant at the circulation desk when a book is requested. If one has access to the stacks, it is necessary to know the call number in order to locate the book by oneself.

Evaluation of Books

When the book is in hand, refer to the title page and check the edition and date of publication. In the field of medicine the date is of particular importance, and most to be observed is the date of copyright usually found on the back of the title page. Often the date of copyright and the date of publication will be the same, but, frequently, books are reprinted at a later date without the addition of any new information. There may be considerable difference in the contents of one book copyrighted in 1940 and printed in 1945 and another both copyrighted and printed in 1945. The latter date does not always mean that the author has covered all the recent developments on his subject up to the time the book goes to press, but in the first case he probably has not added anything new to a book without obtaining a new copyright.

The table of contents following the title page and preface is the next clue to the book's contents. Perusal of the chapter headings will indicate the subjects included and give an outline of the specific points to be found. Indexes generally are found at the back of the book. The usual arrangement is for subjects and authors to be together in one alphabetical list, citing the page number on which material can be located. Index entries found in books often differ appreciably from the standardized subject headings used in library catalogues and published indexes. Thus, some book indexes refer to "spinal anesthesia" and others to "anesthesia, spinal." It is advisable to examine the manner in which the index has been compiled before the book is discarded as not covering a specific subject.

One test of a good book or article is the care with which references are cited. A good bibliography containing accurate references implies that the author has read the works of other contributors in his field and, being conversant with their work, is better able to evaluate his own, giving credit to those whose publications have helped him in the preparation of his work. Although an author may not present a single fact that is new, if his bibliography is well done, the book is not a total loss, for the reader can go to the sources given for further reference. A good book never contains a poor bibliography; a mediocre book may have well prepared lists of references, but a carelessly compiled bibliography is the reader's clue to an author's negligence.

Periodicals in the Library

Periodicals usually form the greater percentage of a medical library's holdings. New developments are first reported in the journals and only later, when they are more generally recognized, are they included in the textbooks and monographs.

The indexes published to cover the field of medicine are among the most important contributions to the advancement of science. Through them the research worker can locate articles on his subject and proceed to read and review those to which he has access. It must be remembered that the standard published indexes used by libraries are far more inclusive than the individual library's holdings. The card catalogue and the card file of periodicals will show the reader which of the references are available in the library.

It is most important to learn thoroughly the use of the medical indexes. In brief form they are explained in the following section.

Medical Indexes

Quarterly Cumulative Index Medicus. Chicago. Old series, volumes 1-12, 1916-1926; new series, volume 1, 1927 to date. Published by the American Medical Association.—The title of the old series, volumes 1-12, 1916-1926, was *Quarterly Cumulative Index to Current Medical Literature.* In 1927 the old series merged with the *Index Medicus* to form the new series, titled *Quarterly Cumulative Index Medicus* which is published four times a year. The volumes for December and June are bound and cumulate the entries for the preceding six months. For the past two years only these two bound indexes have been published.

Arrangement.—Authors and subjects are in one alphabet; complete bibliographic reference is given under the author's name. In the entry under the author's name the title is given in the original language if that language is English, French, German, Spanish, Italian, or Portuguese. If the original article is in any other language, a complete translation is used. Titles entered under the subject always are in English, and all are shortened, expanded, or inverted for the sake of emphasis on the subject. In the old series all titles were translated.

Included in each volume and preceding the index for periodical literature is a list of new books listed according to authors. A classified arrangement of the same list by subjects, a list of journals indexed, and a register of American and foreign medical publishers with addresses follow. The list of journals indexed is especially useful for it gives in full the titles which are abbreviated in the main index and gives the publisher and place of publication also.

The *Quarterly Cumulative Index Medicus* is the most important current international index to medicine and the allied sciences.

Index Medicus. New York, Boston and Detroit; Boston and Washington. Series I, volumes 1-21, 1879-April 1899; series II, volumes 1-18, 1903-1920, and War Supplement, 1914-1917; series III, volumes 1-6, 1921-1926.—This is a quarterly classified record of the current medical literature of the world. Series I and II were issued monthly, series III quarterly. The *Index Medicus* merged with the *Quarterly Cumulative Index Medicus* in 1927. Series I and II constitute a classified index of medical literature. From May, 1899, to December, 1902, publication was suspended, and the only annual index for that period was the *Bibliographia Medica,* which is not nearly so complete or accurate. Series II includes an additional volume known as *Index Medicus War Supplement,* a classified record of the literature of military medicine and surgery, 1914-1917. In series III, 1921-1926, each issue is arranged by subject, but it is necessary to check any subject four times as there is no cumulative subject index. This index is most useful for completing references when the author and date are known, for there is a cross index for author in all volumes.

Series I and II, while comprehensive and accurate, are difficult to consult rapidly. Therefore, in order to obtain subject references for the older literature, unless very complete coverage is

required, it is easier to use the *Index-Catalogue of the Library of the Surgeon-General's Office, United States Army* and for more modern literature, the *Quarterly Cumulative Index Medicus* and *Current List of Medical Literature.*

For the period which it covers, the *Index Medicus* is the most complete index to medical literature; it lists both books and articles in periodicals and contains many references which cannot be obtained elsewhere, not even in the *Index-Catalogue of the Library of the Surgeon-General's Office.*

Bibliographia Medica (Index Medicus). Paris, volumes 1-3, 1900-1902, Published by the Institut de Bibliographie.—This is a classified monthly index which has an author index, but no subject index. The arrangement is somewhat similar to that in the *Index Medicus* but it is neither so comprehensive nor so accurate. It is the only annual index for medical literature during the period when the *Index Medicus* suspended publication and is rather rare.

Index-Catalogue of the Library of the Surgeon-General's Office, United States Army. Washington. Series I, A-Z, volumes 1-16, 1880-1895; series II, A-Z, volumes 1-21, 1896-1916; series III, A-Z, volumes 1-10, 1918-1932; series IV, A-L, volume 1-9, 1936-1945 (dates are those of publication).—Each series of the *Index-Catalogue* comprises a single alphabet. Books, theses, and pamphlets are entered under both author and subject, while articles which were published in journals appear under the subject only. The greatest value of this index lies in the fact that it is a comprehensive cumulative bibliography which makes it unnecessary to search each volume of the annual indexes. With volumes covering the subject of "Anesthesia," taken from all four series, one can obtain a working bibliography which includes practically everything from the oldest historical works on the subject down to literature indexed in the latest volume, in this case, 1936.

Irregularities and omissions.—Details concerning the omissions and irregularities in this index have been omitted from this article, since these are of especial interest to librarians and seldom will trouble the general worker in any field. The full explanation can be found in Cunningham.[1]

Author entries.—Under the author's name, usually with dates of birth and death, can be found: (1) books and pamphlets published as separates, but not articles in periodicals; (2) notations of any works in which the author appears as editor, translator, compiler, and so forth; (3) biographies, portraits, obituaries, and so forth of the author.

Subject entries.—Under subjects, entries are arranged in two alphabets by author; the first gives separates (books and pamphlets). Theses are listed in this alphabet. In smaller type are listed articles in serials. All references are given in their original language, and each reference is complete as it stands.

Current List of Medical Literature. Washington, Volume 1, 1941 to date. Published weekly by the Army Medical Library.—In this index the contents of current journals are arranged under the titles of the journals. The last issue of this index each month contains a

1. Cunningham, Eileen R.: Reference work, including an annotated list of reference books. In: Medical Library Association: **A Handbook of Medical Library Practice** (Chicago: American Library Association, 1943) pp. 371-544.

subject index to the contents included during the month by citing pages. For examples: The October index number refers to "Anesthesia, Curare 558f." In order to find this, look in the October issue which includes page 558. In this case the October 4, 1946, issue carries a page numbered 557-558. Each page has two columns of material, and the numbers actually refer to columns; thus on the page numbered 557-558 the reference to curare will be in the column on the right side of the page. The letter, "f," refers to the location of the reference in relation to the top or bottom of the page as the case may be. When the author, title, and page are found on page 558, refer to the heading which gives the name, volume, month, and year of the periodical. The reference accurately copied can then be located in the issue of the journal; for example: "Azelrad, S. H. The use of curare and cyclopropane in one hundred surgical cases. Current Res. Anesth. 25:158-162, July-August, 1946."

This index is most useful for current articles which have appeared too late for inclusion in the *Quarterly Cumulative Index Medicus.*

Copying and Verifying References

References must be copied accurately in order to locate the article or book. Much valuable time is wasted in hunting because references have been copied erroneously. It is wise to form the habit of writing out a reference completely, copying all the information given in the index: for a journal reference, copy author, title, journal volume, pages, month, and year; for a book reference, author, title, edition, place of publication, publisher, year of publication, and number of pages or volumes.

When a paper is published the references must be verified. The only absolute way to verify a reference is to go to the book or journal and compare the data listed with the published work, because, although they are carefully prepared and compiled, indexes and catalogues have a margin of error commensurate with human frailty. The references given at the end of this paper can be used as examples of the form which is generally accepted in medical publications. These references, which were helpful to me in preparing this paper, will also give more complete information on many of the points which have been glossed over here without many details.[1-6]

Comment

Finally, librarians like to be asked questions. They are glad to assist and to explain, and their reward is competent library patrons. The most satisfactory library experiences come when one has uncovered exactly what was desired. If the problem is involved, it may be necessary to spend hours, even days, and weeks to conclude it. The knowledge that all the processes undertaken have been necessary and not repetitious will help one to stay with a difficult assignment.

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1. Loc. cit.

2. Cunningham, Eileen R.: Method of instruction in the use of the medical library. Bull. M. Library A. **20**:80-89, Jan., 1932.

3. Keys, T. E.: Fundamental concepts of medical bibliography. Minnesota Med. **23**:34-40, Jan., 1940.

4. Marjarum, E. W.: **How to Use a Book** (New Brunswick: Rutgers University Press, 1947) 111 pp.

5. Morton, L. T.: **How to Use a Medical Library** (London: John Bale, Sons & Danielsson, 1934) 70 pp.

6. Postell, W. D.: The use of medical books and libraries. In: **An Introduction to Medical Bibliography** (New Orleans, 1945) pp. 54-91.

SOME EDITORIAL WHYS AND WHEREFORES

M. Katharine Smith, B.A.*
Rochester, Minn.

To the author the work of an editor on a manuscript often seems superfluous and his changes arbitrary; the editor in turn considers the author's work with care and evaluates it carefully. He needs to find good articles for his periodical. Both author and editor have their parts in the preparation of a manuscript for publication.

Of course any author knows that an editor must accept his manuscript or it will not be published. A new author, however, often does not know that, in addition to the content, the form of a manuscript is important in the editor's decision to accept or reject.

Concerning the actual writing of articles, there come to mind certain suggestions which I shall touch on briefly. I do not intend to consider the subject matter of an article; that is the author's responsibility. However, many authors know their subjects but fail to keep to them in their articles; therefore they leave the reader confused. An outline carefully made of the main points to be considered in the subject chosen, and then rigidly followed, with careful culling of extraneous ideas will help all authors. School children make outlines but frequently they do not understand their uses. An outline is merely a pattern. It helps the author construct the article. It is a fence and a yardstick to keep the article within bounds. It helps an author make certain that his points are included and that everything extraneous is excluded.

After the outline is made, the actual writing should follow rather readily. However, attention must be paid to sentence structure and other aspects of grammar. The old-fashioned sentence is still the basis of writing in scientific articles. It includes a subject, a predicate, and certain necessary modifiers; indeed it follows the old definition, "A sentence is a complete thought expressed in words." It begins with a capital letter and ends with a period. The so-called modern form of writing in which a phrase or a word begins with a capital letter and is followed by a period has not been adopted by scientific journals, and therefore an author of a scientific article will do well to refrain from using it.

My last suggestion concerning the actual writing of an article is to avoid the use of extraneous material and allusions and the riding of certain ideas which do not have a definite place in the article. These will merely be removed by the editor.

Since an editor must read many manuscripts, only those which are typewritten are likely to get adequate consideration. They should be typed in double or triple space, with wide margins, on regular manuscript paper which measures 8 by 11 inches. The wide spacing is needed so that the editor may make revisions or if necessary write his questions on the page.

*Division of Publications, Mayo Clinic.

Each page should be numbered, and the author's name should appear on each page. The paging and the name often appear in the upper right hand corner. In my articles the name and page numbers usually are indicated this way: "Smith—2," "Smith—3" and so on.

At the head of the first page should appear the title of the article and, under the title, the author's name in the style in which she wishes it to appear on publication, her position if she wishes to have it appear, and the city and state where she lives.

The text of the article begins below the material listed in the foregoing paragraph. How the pages of text are typed already has been explained. Other parts of the manuscript follow the text in the following order: tables, legends for illustrations, and references.[1] Each table should be typed on a separate page and should be numbered; legends should begin on a new page, and finally the references, if any are used, on another. It is well for an author to alphabetize the references according to the surnames of the authors and to give for each reference the following data in the indicated order: the last name and initials of the author, the title of the article, the name of the journal, the volume number, the inclusive paging occupied by the article, and date of issue of the number of the journal in which the article appeared. This last should include the year, the month, and, if the journal appears weekly, the day. Any standard complete form, however, is acceptable to most editors, who can then revise to suit the style of their own journals. Some editors prefer a certain form and request it.

So much for the work of the author. She has chosen her subject, made her outline, written her article carefully, had it typewritten neatly, and has sent it to the editor.

The editor's work begins with the reading of the manuscript in order to evaluate the content for acceptance or rejection. Many editors of scientific articles do not depend on their own judgment alone in this matter. They send the paper to be read by various authorities. The papers, before they are accepted for the journal in which this article appears, are read by three experts. Any one of these three may advise acceptance as the article stands, or acceptance if the author will admit certain revisions, will make certain revisions, or will elaborate certain parts. Any or all may advise rejection. When a decision is reached the author is notified of the result. If extensive changes are desired or if changes will involve the thought or facts, the author usually is requested to make them. If only small changes are needed, the editor may make them and ask the author's approval either on proof or earlier.

Many factors enter into the final decision about acceptance of an article; a few of them are (1) the content; (2) reader interest in the content; (3) number of papers recently accepted on the same topic or related topics; (4) length of the article; (5) style; (6) amount of editorial work necessary to prepare the article for publication.[2]

After acceptance of an article the actual editing begins. Lohr[3] has stated:

1. Hewitt, R. M.: Partial guide for authors in the Mayo Clinic and the Mayo Foundation. Revised (Privately printed, 1946) 40 pp.

2. Hewitt, R. M.: Personal communication to the author.

3. Lohr, L. R.: **Magazine Publishing** (Baltimore: The Williams & Wilkins Company, 1932) 328 pp.

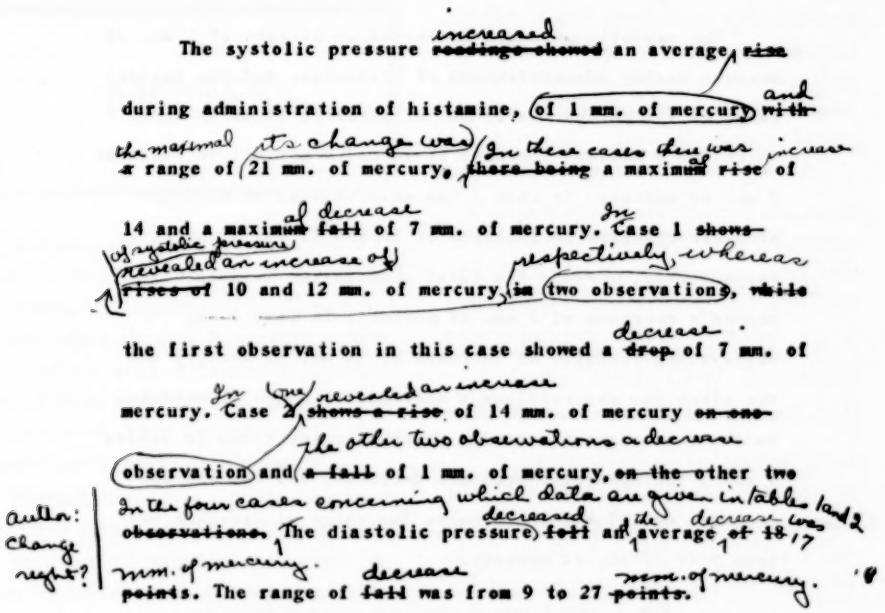
The systolic pressure increased readings showed an average rise
during administration of histamine, of 1 mm. of mercury and with
the maximal its change was In these cases there was increase
a range of 21 mm. of mercury, these being a maximum rise of
14 and a maximum decrease fall of 7 mm. of mercury. In Case 1 shows
of systolic pressure
revealed an increase of
rises of 10 and 12 mm. of mercury, in two observations, respectively, whereas while
the first observation in this case showed a drop decrease of 7 mm. of
mercury. In Case 2, one revealed an increase shows a rise of 14 mm. of mercury on one
observation and the other two observations a decrease
a fall of 1 mm. of mercury, on the other two
observations. In the four cases concerning which data are given in Table 1 and 2
The diastolic pressure decreased fell an average of 18.7 mm. of mercury.
points. The range of decrease fall was from 9 to 27 points. mm. of mercury.
author: Change right?

Fig. 1.—Editorial changes made in preparation of a paragraph for publication.

"The more responsible the magazine the more copy is edited even to complete rewriting." If much editing is necessary the manuscript may be returned to the author with suggestions for changing it. The editing falls into three main divisions: (1) confirming facts and studying arrangement, presentation, and continuity of thought; (2) correcting grammar, style, and typographical errors, and (3) marking the manuscript for the printer.

Facts are confirmed by the board of experts and always by the editor as far as possible because even a noted authority may write something different from what he thinks he has written. Although in the last analysis the author is responsible for the facts, the editor does everything practicable to prevent publication of incorrect statements.

By rearrangement of paragraphs, sentences, and words and by deletion of verbosities an editor may make an inept article into a clear, concise one. It is difficult to explain how that is done, but often it is done.

The editor next corrects the grammer, punctuation, and spelling and puts the article into the style of the journal (figs. 1 and 2). Each journal has a certain style which it follows. Since there are many choices to be made, the editor makes the choice and establishes a style for the journal, which is followed thereafter. For instance "amytal" may be printed with an initial capital letter or without one. Amounts may be written as "2 c.c."; "2 cc." or "two cubic centimeters." The editor establishes his choice and makes all the copy conform.

The editor may delete any verbose, redundant statement. Furthermore he usually leans over backward to keep the tone of his publication on a high plane or to try to improve the quality

The systolic pressure increased an average of 1 mm. of mercury during administration of histamine, and the maximal range of its change was 21 mm. of mercury. In these cases there was a maximal increase of 14 and a maximal decrease of 7 mm. of mercury. In case 1 two observations of systolic pressure revealed an increase of 10 and 12 mm. of mercury, respectively, whereas the first observation in this case showed a decrease of 7 mm. of mercury. In case 2 one observation revealed an increase of 14 mm. of mercury and the other two observations a decrease of 1 mm. of mercury. In the four cases concerning which data are given in tables 1 and 2 the diastolic pressure decreased and the average decrease was 17 mm. of mercury. The range of decrease was from 9 to 27 mm. of mercury.

Fig. 2.—Final form of paragraph shown in figure 1.

of the writing. According to Lohr, therefore, the editor may delete any statement which will hurt the interests or sensibilities of the reader, any invocation of higher authority, anything concerning a personal controversy or personal advertising, defamatory remarks about government, about foreign countries, and, I will add, about persons.

Marking up a manuscript for the printer comes next and demands knowledge of type and other equipment available in the shop where the type is to be set. After the type has been set the author receives galley proof to read. Changes at this time should be kept to a minimum, but necessary corrections can be made.

I have tried in this brief article to give the high lights in the preparation of a manuscript for the editor and printer. The author and the editor both give much hard work to it and each contributes to the finished article.

MEASUREMENT

(Continued from page 246)

A's should be assigned and fewer than that percentage of F's should be given. In other cases the opposite distribution is justified. Again the members of the class may possess similar abilities, and there should be more C grades and fewer high and low grades. The distribution of grades given in the figure is what one would expect to find in a large beginning class. In smaller classes or when the students have been selected, a normal distribution is the exception rather than the rule.

Summary

Grades assigned by use of statistical formulas such as the percentile rating and average deviation are reliable, for, regardless of the ease or difficulty of the test, the grades always represent the same degree of deviation from the average score or mean.

NOTES

Technic of Administration of Curare.*—It is our practice to use curare (Intocostrin, Squibb) in small repeated doses rather than in large single doses. The effects after intravenous injections are of short duration. The drug is partly destroyed in the liver and partly eliminated unchanged by the kidney.

Pentothal sodium, a 2½ per cent solution given by the Thomas technic, is used for all inductions in adults unless contraindicated. If open drop ether is used, oxygen, 1,000 to 2,500 L. per minute, is given continuously through a nasal catheter.

Adults are carried to the third plane of the second stage of anesthesia. The airway is introduced as soon as tolerated; a free airway must be maintained because paralysis of the glottis with laryngeal obstruction may appear, especially with deep curarization.

Intocostrin does not take the place of the anesthetic agent, but greatly reduces the amount of the anesthetic agent needed. We do not attempt to produce complete relaxation for abdominal surgery. If the initial dose does not produce the required relaxation, a second dose of 1 to 2 cc. (20-40 mg.), depending on the size and condition of patient, is administered. In most cases the initial dose is sufficient.

In aged and poor risk patients a smaller initial dose, 1 cc. (20 mg.), is used and followed with ½ cc. (10 mg.) when necessary. For children the dose is very small, usually 3 to 4 minims, given into the muscle 10 minutes before the incision is made.

Preanesthetic medication is the same as for all other anesthetics. Prostigmine, 1/2,000, curare's antagonist, and efficient means for carrying out artificial respiration are always on hand.

A. Louise Tyler, Chief Anesthetist, St. Michael's Hospital, Newark, N.J.

Use of Airways.—An unobstructed airway is a most important factor in the safe and satisfactory management of all types of anesthesia. Often a satisfactory airway may be obtained by supporting the patient's jaw or by turning the patient's head from one side to the other until breathing is free and easy, but more often, especially for long operative procedures, it is necessary to use some device which will prevent the tongue and epiglottis from obstructing the space above the larynx. Two devices often used to relieve obstruction of airflow in the oropharynx are (1) the oropharyngeal airway and (2) the nasopharyngeal airway.

There are several types of oropharyngeal airways. Some are made of metal and others of rubber. They are shaped to fit between the teeth and lips and over the curve of the tongue and to rest on the posterior wall of the oropharynx, between it and the base of the tongue. They are available in different lengths. An oropharyngeal airway is usually hollow to allow air to pass through and around it. Some of the openings are large enough to permit

*From a paper on "The Use of Curare in Inhalation and Intravenous Anesthesia," read before the New Jersey Association of Nurse Anesthetists, Atlantic City, May 16, 1947.

the insertion of a rubber catheter if necessary for suction for removal of any foreign bodies that may cause obstruction. Some oropharyngeal airways have a small nipple-like piece to which a catheter may be connected for suction or insufflation.

Smooth anesthesia is often disturbed by too early introduction of the oropharyngeal airway. It is always advisable to wait until the pharyngeal and laryngeal reflexes are depressed before the airway is inserted, or gagging, emesis, and laryngospasm may result. It should be emphasized that the insertion of an oropharyngeal airway does not guarantee a free airway. Usually it is still necessary to support the mandible at the center by forward pressure.

To insert an oropharyngeal airway without trauma to the mucous membrane, the airway should be held at the lip end in one hand, while the forefinger of the other hand is slipped outside the teeth, inside the cheek, and into the space behind the last molar. The mouth will then usually open with slight pressure on the mandible. The airway is then passed very carefully over the tongue until the tip rests on the posterior wall of the pharynx. It is usually wise to wet or lubricate the airway to facilitate insertion.

The nasopharyngeal airway is a large rubber tube. It is passed through one side of the nose and the nasopharynx, into the oropharynx, and behind the tongue. This procedure is most useful for patients whose mouths cannot be opened, or for those for whom an oropharyngeal airway of proper size is not available. This type of airway may be used in an emergency when there is obstruction before the pharyngeal and laryngeal reflexes are depressed.

A nasopharyngeal tube should have a wide lumen and a thin but sturdy wall. The end should be beveled and smooth, and the tube should be well lubricated to permit its insertion without causing trauma. The tube should be approximately 22 cm. long for adults. An old endotracheal tube makes an excellent nasopharyngeal airway.

The administration of an anesthetic should not be started without having the means for suction readily at hand. The possible need to remove foreign bodies from the pharynx or larynx must always be anticipated before an anesthetic is started.

Intratracheal anesthesia produces an absolutely free airway for the patient. It is agreed that the most common difficulty in administering an inhalation anesthetic is obstruction of respiration. Intubation eliminates this possibility. With a tube in the trachea, the occurrence of laryngospasm does not interfere with the respiratory exchange.

Laryngospasm is often induced by surgical stimulation during light anesthesia. To prevent this cause of obstruction, we intubate the larynx in order to maintain a light safe plane of anesthesia without danger of reflex spasm. Laryngospasm occurs most often during abdominal operations as a result of traction on the peritoneum. This spasm in turn causes lack of oxygen, the muscles become tense, and it is very difficult for the surgeon to continue the operation. Until the spasm is relieved and a good airway is re-established, it is often impossible to deepen the anesthesia.

Agnes S. Bennett
St. Francis Hospital
Trenton, N. J.

CURARE: AN ADJUVANT IN ANESTHESIA. —The typical curare action consists essentially of an interruption of nerve impulses to the skeletal muscle at the myoneural junction. When a drug having a pure curare action is introduced intravenously, it rapidly produces a paralysis involving the skeletal muscles. The diaphragm and intercostal muscles being the last to be affected, embarrassment of respiration is a late phenomenon. The drug is partly destroyed in the liver and is rapidly eliminated by the kidneys. No evidence has been encountered to show that liver or kidney impairment prolongs or intensifies the action of curare. No direct effect on the heart has been reported.[1]

The employment of curare as a safe and useful adjuvant to anesthesia depends upon its judicial use in conjunction with properly administered agents. When it is used with any agent, it is essential that the optimal state be recognized, a very narrow margin existing between this and the stage of overdosage.

In our hospital, preliminary medication is similar to that used for ordinary procedures. Heavy sedation should be avoided. The technic applied may vary according to preference of the individual anesthetist.

If cyclopropane is the anesthetic agent, the usual carbon dioxide absorption technic is used to induct and establish anesthesia. The intravenous administration of a solution of 5 per cent dextrose in saline is started when the patient is placed on the table. A light second plane stage of anesthesia is maintained. As the incision is being made, 2 or 3 cc. curare is injected into the intravenous tubing. If relaxation is not sufficient and the intestines are not contracted when the peritoneum is opened, one half the initial dose of curare is repeated. If the optimal state is still not attained, 1 cc. is repeated at three to five minute intervals until a quiescent abdomen is achieved. Thereafter, unless the operation is prolonged, an additional amount is seldom required until prior to closure of the peritoneum, when 1 cc. is injected. When the peritoneum is closed, cyclopropane is discontinued, and the patient is placed on a 50 per cent mixture of nitrous oxide and oxygen and is fully reacted at the end of the operation.

Curare is effectively employed in operations on the upper abdomen. Frequently when the upper abdominal organs are involved in the operation, the stomach dilates, causing regurgitation and incurring danger of aspiration. It is therefore advisable that a Levine tube be inserted before induction.

For pelvic operations, the extreme Trendelenburg position and extensive packing are unnecessary and should be avoided because of pressure against the diaphragm.

Curare may be used with ether or nitrous oxide. When ether is used, the amount should be reduced to one third or less.

If respiratory arrest should occur, the anesthetic should be discontinued, and controlled respiration by manual compression of the breathing bag employed until natural respiration is restored. If the arrest is prolonged, prostigmine may be given intravenously. In the course of an operation, adequate pulmonary ventilation should be assured

(Continued on page 266)

1. Cullen, Stuart C.: Clinical and laboratory observation on the use of curare during inhalation anesthesia. Anesthesiology **5**:166-173, Mar. 1944.

THE NEWS

MISS RICHARDS RE-ELECTED PRESIDENT OF A.A.N.A.

First Award of Appreciation to Barnes Hospital

At the fourteenth annual meeting of the American Association of Nurse Anesthetists, covening in Kiel Auditorium in St. Louis, Sept. 22-25, Lucy E. Richards, chief staff anesthetist at Cleveland City Hospital, was re-elected president. Other officers re-elected were Myra VanArsdale, chief staff anesthetist at St. John's Hospital, Cleveland, 1st vice president; Gertrude L. Fife, Cleveland Heights, treasurer. Mabel E. Courtney, assistant in the Grace Hospital Department of Anesthesia, Detroit, was elected 2nd vice president. New trustees are Major Edith Aynes, Public Relations Department, Surgeon General's Office, Washington, D. C.; Verna Bean, St. John's Hospital, Brooklyn, N. Y.; Gertrude Troster, Memphis, Tenn. Members elected to the Nominating Committee were Hazel Blanchard, Pennsylvania; Ragna Wigen, Washington; Billie Caraway, Georgia; Harriet Aberg, Illinois. The Board of Trustees' appointment to the committee was Ruth Bergman, Minnesota.

At the annual banquet on Sept. 24, an award of appreciation, the first to be presented by the Association, was given to Barnes Hospital "In recognition of its contribution to the education of the nurse anesthetist." In presenting the award to Dr. Frank R. Bradley, director of Barnes Hospital, Miss Richards said:

"In the life of an organization, as well as in the life of an individual, there comes a time when it seems appropriate to pause in working toward a goal and take stock of the friendships that have contributed to the organization's advancement. That time has come for the members of the American Association of Nurse Anesthetists. Although there is still much to be done we have, with the help of friends, made much progress. And to those who have given us their help, it is time for us to express our gratitude.

"As individuals, we are grateful to those older members of the medical profession who recognized the nurse as an anesthetist and made her development possible. We are sure that her early sponsors were not unaware of her gratitude as expressed in her conscientious attention to the work for which she was trained. Dr. George Crile, the Doctors Mayo, and Dr. Evarts A. Graham, among the surgeons, and Dr. Robert H. Bishop, Jr., and Dr. Bert Caldwell, among the hospital administrators, were undoubtedly cognizant of her appreciation.

"At this annual convention, the Board of Trustees of the American Association of Nurse Anesthetists is making the first of a series of contemplated awards of appreciation to medical groups and individuals who have contributed to the advancement of the nurse anesthetist. Since the first award is being made this year, it seems most appropriate that it should go to an institution in the city of which we are guests. To this gathering of nurse anesthetists, there is no need to recall the stature of Barnes Hospital. There is even less reason to point out what good friends the nurse anesthetist has in Dr. Frank R. Bradley and Dr. Evarts A. Graham, who is at present in Europe and is unable to be with us. They have given us encouragement when it was most needed, and

to men like them, the Association owes a great deal.

"Accordingly, for the Board of Trustees of the American Association of Nurse Anesthetists, acting on behalf of all its members, I take the occasion of this meeting in St. Louis to say to Dr. Bradley, and through him to Barnes Hospital, 'We thank you.' "

In accepting the award, Dr. Bradley paid tribute to the director of the Barnes Hospital School of Anesthesia, Helen Lamb:

"Madam President, Members of the American Association of Nurse Anesthetists, and Friends:

"On behalf of the Trustees of Barnes Hospital, we accept with sincere appreciation this award. In honoring us, you honor three individuals who contributed so greatly to the education of the nurse anesthetists in our institution—Miss Helen Lamb, director of the school of anesthesia and chief anesthetist; Dr. Evarts A. Graham, chief of surgery and professor of surgery in Washington University School of Medicine; and Dr. L. H. Burlingham, now deceased, who was administrator of Barnes Hospital when the school was started. The primary function of medicine and surgery, and, therefore, of the hospital and all who work in the hospital, is the care of sick and injured persons. That care implies the relief of pain. Without the nurse anesthetist, the ability of the modern hospital to relieve pain would be seriously hampered. The nurse anesthetist fills an essential need in medicine, and she is here to stay. Our heartfelt congratulations to you as a profession!"

At the annual banquet Miss Richards also announced an initial gift of $300 from Mr. and Mrs. A. N. Haskell of Detroit to be used for scholarship purposes. In making the announcement Miss Richards said:

"One objective of our association is to maintain educational standards. This is not only an ideal but an objective that must be realized in a practical manner. It has been our hope that as an association we could contribute materially to the education of the nurse anesthetist. Accordingly, it is my pleasure to announce a gift of $300 to the Association from Mr. and Mrs.

Miss Lucy Richards presenting award of appreciation to Dr. Frank R. Bradley at fourteenth annual banquet.

A. N. Haskell of Detroit, this fund to be used for scholarship purposes. It is the wish of the donors that the fund be used to aid graduate nurse anesthetists in preparing themselves to teach in a school of anesthesia. As chairman of the Board of Trustees and for the members of the American Association of Nurse Anesthetists, I wish to thank Mr. and Mrs. Haskell for their generous gift to our educational program."

Assembly of Schools of Anesthesiology

A total of 78 members registered for the second Assembly of Schools of Anesthesiology, held on Sept. 20 and 21, at the Hotel DeSoto in St. Louis. Esther Myers Stephenson was director of the Assembly and Marion Wark Thomas the assistant director. Co-ordinators for the closed session on Sept. 20 were Mabel Courtney and Myra VanArsdale.

At this closed session for the directors of the schools of anesthesia or their authorized representatives, no apparent shortage of entrants for the schools of anesthesia was reported. The present shortage of nurse anesthetists was ascribed to an increased demand for the nurse anesthetist's services. In a discussion of ways and means of increasing the number of nurse specialists in the field, emphasis was placed on distributing guidance material to schools of nursing, revising prospectuses of the schools of anesthesia, improving personnel practices, increasing training facilities, and encouraging more anesthetists to enter the teaching field.

At the Sunday session of the assembly, open to all members of the Association, Dr. A. R. Gilliland and Dr. Joe Park, both of Northwestern University, Evanston, Ill., were among the outstanding speakers. In reporting the results of the fourth and the fifth qualifying examination, Janet McMahon, chairman of the Examination Committee, announced the formation of work groups for the construction of test items for the qualifying examination.

Proposed Revision of By-Laws

In voting to accept a proposed revision of the by-laws providing for the admission to membership of any eligible "person," the members at the business session of the annual meeting provided for the admission of male nurses and nurses from foreign countries. Other accepted revisions include the following:

Hereafter the applications of members for inactive membership are to be notarized; formerly such applications were signed by two active members.

A degree of Honorary Membership may be conferred upon any person whose name has been recommended by the Board of Trustees and approved by the vote of the members of the Association.

State and local associations with the approval of the Board of Trustees may establish qualifications for membership in the local association. Membership in the national association may be conferred upon an eligible person even if he does not meet the requirements in the local association. The by-laws as accepted also authorize the formation of local associations not limited to states. Assemblies comprised of unorganized as well as organized states will receive from the national treasury a per capita amount for the members in unorganized states equal to that given to the assembly by organized states in the same assembly. State associations are also to receive two-thirds of the penalty fees collected by them.

In the revised by-laws provision has been made for a standing committee

Mrs. Fife, Mrs. Van Arsdale, and Miss Richards at a tea for the alumnae of Barnes Hospital School of Anesthesia, on September 21 in St. Louis.

on Government Relations. This committee will study existing laws of the various states dealing with the medical practice acts and other laws affecting the nurse anesthetist. It will report on pending legislation and make recommendations to the Board of Trustees. This committee will work with the local association committees on legislation and, with the approval of the Board of Trustees, will employ legal counsel.

The article on "Voting" was referred back to the Revisions Committee for further study.

State Representation

The total registration for the fourteenth annual meeting was 269 members, representing 37 states and the District of Columbia. The largest number of delegates was from Missouri, with Illinois running a close second. Next in order were Michigan, Texas, and Ohio. Twenty state associations were represented by the state association presidents.

FROM THE STATES

The New Jersey State Association of Nurse Anesthetists, as of September, plans to hold meetings every other month. The annual meeting will be held in conjunction with the annual meeting of the New Jersey Hospital Association. On May 16, the association received its papers of incorporation from the state of New Jersey. . . . The

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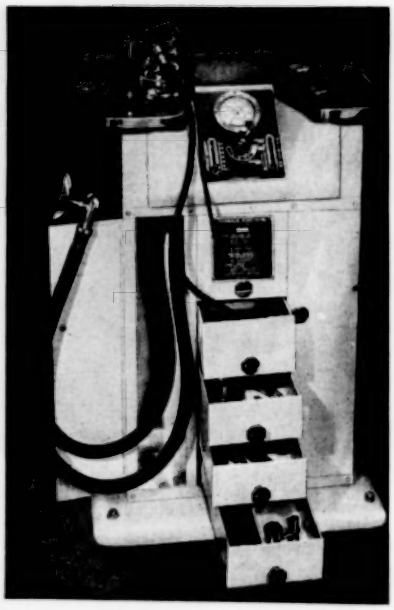

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Stephenson Corporation
Red Bank New Jersey

Board of Trustees of the Michigan State Association of Nurse Anesthetists will hold an annual meeting in Detroit after the Tri-State Assembly. In 1948 it will be held at the Mt. Carmel Mercy Hospital. . . . On Oct. 26, the members of the Minnesota Association of Nurse Anesthetists were guests of the Mayo Clinic in Rochester, Minn. Florence McQuillen was in charge of local arrangements.

DEATHS

Nell Snodgrass Davidson of San Angelo, Texas, died on Aug. 19, 1947. Mrs. Davidson took her special training in anesthesia at the Barnes Hospital School of Anesthesia in St. Louis and was employed at St. John's Hospital in San Angelo at the time of her death.

Lt. Helen C. Seni, a member of the Nebraska Association of Nurse Anesthetists since 1939, died on Jan. 20, 1947, at the 98th General Hospital in Munich, Germany. Lt. Seni was a graduate of St. Joseph's Hospital School of Nursing, Alton, Ill., and took her training in anesthesia at St. John's Hospital School of Anesthesia in Springfield, Ill.

Capt. Jean Anne Hymers, a member of the Illinois Association of Nurse Anesthetists, died on Mar. 12 in Tokyo. Capt. Hymers was a graduate of the Rumford Community Hospital School of Nursing, Rumford, Maine, and of the Barnes Hospital School of Anesthesia in St. Louis.

Applications for inactive membership for 1948 must reach the Executive Office by Jan. 15, 1948. Application forms may be obtained by writing the Executive Office.

ABSTRACTS

Ruth, H.S.: Anesthesiology today and tomorrow. Bull. Maryland Univ. School of Med. 31:125-130, Jan., 1947.

"Anesthesiology is a century old today . . . but . . . its growth . . . and development . . . have been inhibited somewhere, somehow . . . After the original discovery of satisfactory pain relief had been established, the administration of anesthesia by inhalation and injection of drugs was placed in the hands of almost any available person. . . . The severity and prolonged nature of surgical interventions common today have changed this situation . . . the art of anesthesia has gradually developed from the clever and skillful administration of drugs into a combination of art and science; art in the necessary personal contact with fellow medical practitioners, in sympathetic understanding of their problems, in the approach to patients, and in the technic of the administration of drugs; science in the prevention of harm to the physiologic welfare of the patient. . . . The responsibilities of an anesthesiologist today vary. . . . I shall first consider the relationship of a department of anesthesiology that is well established with competent personnel with the surgical department. A member of the former will visit all surgical patients preoperatively. . . . The selection of the anesthetic agent and the method of its administration is decided preferably by him at this time. . . . Prescriptions are written for the preanesthetic sedative drugs. . . . The anesthesiologist can frequently make valuable additional suggestions toward the preparation of the patient in other respects. . . . During the period of surgery, anesthesia is administered not only with the objective of pain relief, but in such a manner as to provide the nearest to ideal working conditions for the surgeon . . . the patient is, in reality, prepared for his convalescence during the period of anesthesia. The state of function of his respiration and circulation is observed particularly and maintained on the highest possible efficient level; he is protected, where possible, from detrimental reflex activities, and automatically and promptly rendered treatment for untoward developments during this period. Preoperatively the anesthesiologist is available for consultation in the recognition of and suggestions for treatment of complications. . . . An excellent technician will delight the surgeon during the anesthetic period, but without preparation in the other requirements, may produce a fatality by error in judgment or inability to protect the patient from accompanying detrimental forces. A lack of technical training and extensive clinical experience can also invite disastrous consequences. . . . The general field of medicine has also received the beneficial effects of services offered by anesthesiologists. . . . The future of anesthesiology . . . would appear to be essentially brilliant in possibilities. . . . During the war, many surgeons of military age for the first time performed surgery under conditions provided by anesthesiologists. According to the statements of anesthesia consultants active in the armed forces, and the reports of others, the majority of these surgeons are not now willing to retrogress to former working conditions."

Moore, B. E.: The contribution of anesthesia to psychiatry. Yale J. Biol. & Med. **19**:195-206, Dec., 1946.

"The value of anesthesia to surgery and the relief afforded to suffering mankind have been of such overwhelming significance as to obscure completely the contribution of anesthesia to psychiatry. . . . The use of anesthetic agents to produce a twilight state of disturbed consciousness, during which the inner recesses of the mind may be explored, is now a well-established method in the armamentarium of the psychiatrist. . . . In narcoanalysis the patient is given an injection of an intravenous barbiturate, usually sodium amytal or pentothal. Through their anesthetic action, which we do not fully understand, these drugs produce a disturbance of consciousness, a sort of twilight state between sleep and wakefulness, in which stimuli are distorted and the censoring of thought and emotion is less effectively maintained. During this twilight state, a phenomenon known as 'abreaction' is likely to occur. This is the dramatic re-enactment of the terrifying event which precipitated the patient's mental disorder and which has for him highly significant emotional meaning with respect to his childhood conflict. At the same time, there may be revealed some of the intense repressed emotions and feelings which are unacceptable to the conscious state. . . . Although the patient is likely to have at least partial amnesia for the abreaction of the psychologically traumatic event, fragments may be remembered. . . . The essential feature of this treatment technic is the disturbance in consciousness which permits the release of emotional feelings and strivings which have been long repressed."

Beecher, H. K., and Linton, R. R.: Epinephrine in cardiac resuscitation. J.A.M.A. **135**:90, Sept. 13, 1947.

"Twice, after periods of cardiac standstill of thirty and twelve minutes, respectively, epinephrine produced resuscitation of the heart, although needle pricks had failed to do so. . . . When epinephrine is employed in cardiac resuscitation, doses that seem to us to be dangerously large (namely, 1 cc. of 1:1,000 solution of epinephrine hydrochloride) are often used, with the hazard of production of ventricular fibrillation. . . . In adults who have impaired hearts, and any heart in standstill is at least acutely impaired, it is doubtful if more than 0.2 to 0.3 cc. of 1:1,000 solution of epinephrine hydrochloride ought to be used, and this should be diluted ten times before injection into the right auricle. . . . Accompanying massage of the heart is probably of great importance. Of course oxygenation should be maintained by artificial respiration with an oxygen-rich atmostphere, and the falling blood pressure . . . supported by transfusion."

CURARE

(Continued from page 259)

by manual compression of the breathing bag at regular intervals.

Bronchospasm has been known to occur at the termination of the anesthetic and is associated with the use of prostigmine. Prostigmine should therefore be used with caution. If bronchospasm does occur, artificial ventilation with oxygen, atropine given intravenously in large doses, and more curare may be helpful.

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BOOK REVIEWS

The Development of Inhalation Anaesthesia. By Barbara M. Duncum, D. Phil. (Oxon) of Nuffield Department of Anaesthetics, University of Oxford. Cloth. 640 pages, 161 illustrations. New York: Oxford University Press, 1947. $12.00.

This history of inhalation anesthesia covers primarily the years from 1846 to 1900. A 50 page introduction lays an economical, social, and political background for the development of anesthesia. The author quotes many passages from documents related to the subject. Footnotes are used to indicate sources and to add comments. The histories of various anesthetic agents are developed, as well as the stories of the pioneers in the field of anesthesia. Many pictures of persons and apparatus are reproduced. Some of the pictures are rare and have not been published previously. A summary of events which occurred in the period from 1772 through 1911 is arranged in chronologic order. The book is indexed.

Curare. Its History, Nature, and Clinical Use. A. R. McIntyre, M.D., Professor of Physiology and Pharmacology, College of Medicine, The University of Nebraska. Cloth. 240 pages, 25 illustrations. Chicago: The University of Chicago Press, 1947. $5.00.

The title of this book covers the contents briefly but does not, of course, give any idea of the wealth of material which the author has carefully prepared. Misconceptions concerning curare are investigated and set in order. Details concerning the early history of curare are given, and this topic, as well as others, is well documented. After each chapter an extensive bibliography on the subject covered is presented. In addition to the text, tables are used to present in a concise manner various subjects, such as geographic, botanical, chemical, and other data as related to curare.

Some new experimental studies as well as older studies are included. Clinical uses of curare are discussed in one chapter. To this chapter alone there are 259 bibliographic references. Several chapters cover the actions of curare. A list of articles which appeared while the book was in the process of publication is included as an addendum. Two indexes, one of subjects and the other of authors, with numbers indicating bibliographic citation, complete the volume.

Practical Anesthesia for Dental and Oral Surgery. Local and General. By Harry M. Seldin, D.D.S., F.I.C.D., F.I.C.A., Consulting Oral Surgeon, Harlem Hospital, New York City Cancer Institute and Peekskill Hospital, Peekskill, New York. Cloth. 562 pages, 238 illustrations. Philadelphia: Lea & Febiger, 3rd Ed., 1947. $8.50.

This edition, the third, follows the second edition after an interval of five years. The rapid advancement in anesthesia, especially as it pertains to dentistry, made the revision seem necessary. The first part of the book, consisting of 12 chapters, is concerned with local anesthesia. The second part, consisting of 19 chapters, covers the field of general anesthesia. Some of these chapters consider intravenous anesthesia, resus-

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citation, analgesia, and history. Clinical use of several agents by various methods is described.

Tables, diagrams, and pictures are used liberally throughout the book. For the discriminating anesthetist who is interested in dental anesthesia the book does cover the subject. Some of the ideas and technics are not considered good practice by many anesthetists; for instance, the use of ethyl chloride by spraying for inhalation anesthesia is generally not considered the best method. The book is well indexed.

Nitrous Oxide-Oxygen Anesthesia. By F. W. Clement, Major M. C. (A.U.S.). Cloth. 288 pages, 92 illustrations. Philadelphia: Lea & Febiger, 2nd Ed., 1945. $4.50.

This book probably needs no introduction to readers of this review. It is the second edition, thoroughly revised, of a previously published work. Greater detail is given in the chapters on dental anesthesia, and newer concepts are included in other chapters. Figures and tables supplement the text. Short lists of bibliographic references follow each chapter. The book is briefly indexed.

How to Use a Book. By E. Wayne Marjarum. Cloth. 111 pages. New Brunswick: Rutgers University Press, 1947. $1.50.

This small book is filled with many valuable aids to the reader, and the information is presented in such a delightful manner that learning from it becomes a pleasure. The reader is stimulated to learn about books. The primary purpose of the book is, according to its author, "to help the many persons who must go to books for information and ideas." Suggestions on retaining what one reads comprise the first chapter. Preparation of notes and files, indexing, indications of fatigue, the selection of material for remembering, speed of reading, and adaptations by the individual are all discussed. A chapter considers the habits of rapid reading. The anatomy of books introduces or, for some readers, reviews the subject of the parts of books and their functions. The fourth chapter outlines the use of libraries, how to locate and select books in the library, and the use of encyclopedias, biographical works, and dictionaries. An appendix lists several categories of books which help the reader to find information or sources of information. The book contains a glossary of abbreviated and complete terms common in books, and a brief index completes the volume.

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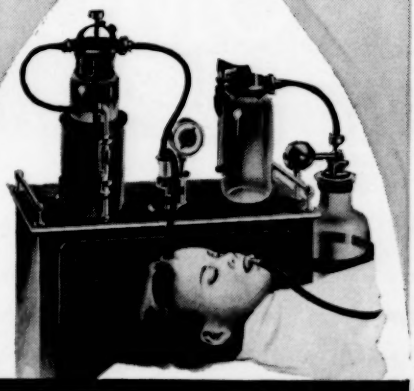

*Karp, M., and Teuscher, G. W.: General anesthesia in the difficult pedodontic patient, J. Pediat., 30: 317 (Mar.) 1947.

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BROMURAL (alphabromisovalerylcarbamide) *Council Accepted*

Available in 5 grain tablets and in powder form . . .

KNOLL BILHUBER

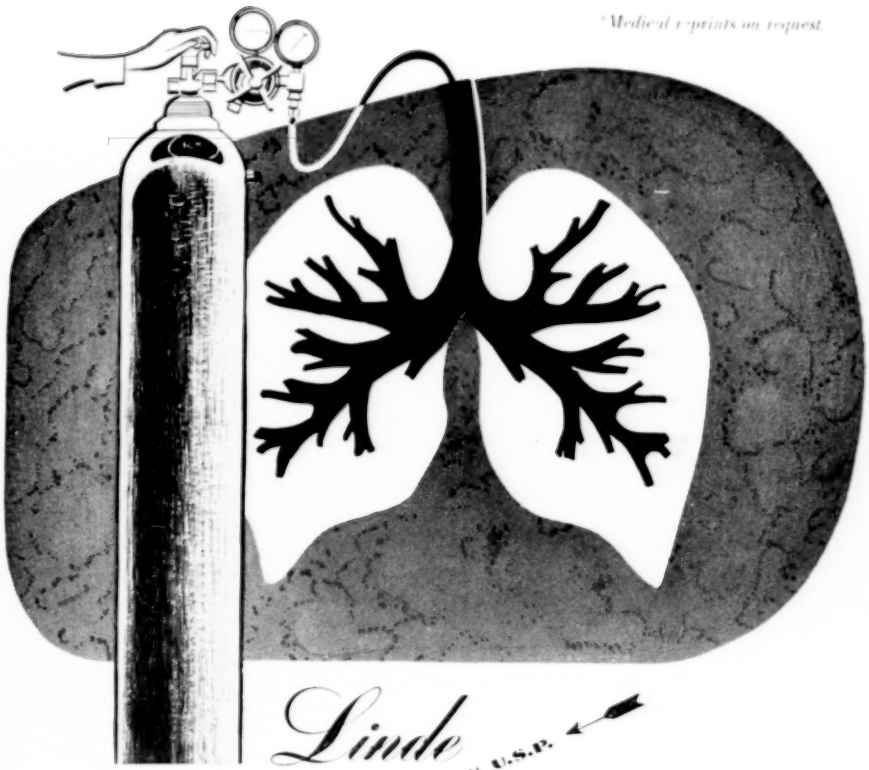
BILHUBER-KNOLL CORP. ORANGE, NEW JERSEY.

When the lungs don't function properly . . .

tissues may not receive adequate oxygen. Oxygen therapy helps the lungs deliver a more nearly adequate supply of oxygen to the blood and tissues.* ▶ *Ask to be put on the list to receive the* OXYGEN THERAPY NEWS, *Linde's monthly abstract publication for physicians interested in oxygen therapy.*

▶ *Refer to Bulletin G.*

* *Medical reprints on request*



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OXYGEN U.S.P.

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

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Ohio Medical Gases include Nitrous Oxid — Ethylene — Cyclopropane — Oxygen — Carbon Dioxid — Oxygen-Carbon Dioxid Mixtures — Helium — Helium-Oxygen Mixtures

Within the cylinder a clear, colorless substance—partly liquid and partly gas. To keep Ohio Nitrous Oxid absolutely pure, cleanliness is a fetish with us. In order to assure purity of content, each empty cylinder is carefully inspected, painted, then thoroughly cleaned by vacuum to remove any trace of foreign substance. Next comes the filling and the final tests for quality and purity; last of all the "Ohio" label that certifies this quality and purity to you.

It's what you can't see that makes "Ohio" the brand to specify when you order Nitrous Oxid.

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